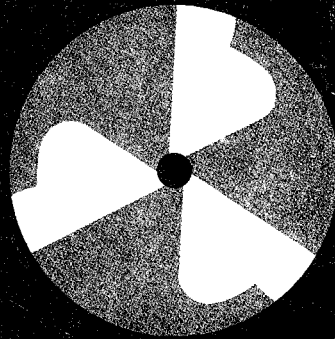


Annual Report

1973-74



Cyclotron Laboratory
Michigan State University

ANNUAL REPORT
of the
MICHIGAN STATE UNIVERSITY
CYCLOTRON LABORATORY*
for the period
July 1, 1973 to July 1, 1974

By
Project Staff

September 1974
East Lansing, Michigan

*Supported jointly by National Science Foundation, Atomic Energy Commission, Office of Naval Research and Michigan State University (see Preface for details).

PREFACE

Our annual report this year is again a composite document, covering all nuclear programs of the MSU Cyclotron Laboratory and submitted to all of the agencies which support programs in the laboratory. In addition to Table I below, which lists sources of current support, we call special attention to the fact that the National Science Foundation was responsible for the construction of the laboratory and in this way contributes substantially to the support of other agency research programs which use the facility. As is clear from Table I, the major operating support comes from the NSF, and substantial support from Michigan State University. Other funding includes the Atomic Energy Commission which supports the Nuclear Chemistry group, and the Office of Naval Research whose support of neutron research is due to end shortly. In Table II we list the faculty, research associates, and graduate students in the laboratory, together with the grants or contracts to which they are attached. This listing in Table II includes all persons who were at the laboratory for any part of the year 73-74. Those who have left the laboratory, either during the year or since, are identified by an entry in the present address column.

In our annual report this year we continue with the brief write-ups on "Research in Progress". These write-ups, although often incomplete, give an up-to-date presentation of current activity in the laboratory. Following the pattern of last year, we are including in this report the abstracts of papers delivered in meetings, the abstracts of papers in press

after July 1, 1974 and the title pages of articles published during the year. Hopefully this first page presents sufficient information for a reader to ascertain if he is interested in that particular article, so that he can then refer to the appropriate journal or contact the author for reprints.

The level of research activity is very high and the enthusiasm of the research group is infectious. The flow of accurate and significant information on nuclear phenomena continues to justify the years spent on improved instrumentation. A substantial effort has also been spent in investigating a new type of accelerator using a superconducting-coil magnet, and in searching for ways our laboratory can have an impact on Energy and Environment related problems.

One of the major purposes of an annual report is to give others the necessary information to assess the state of our current program. If you feel inclined to make comments to us on the program we would welcome them. Finally, we welcome collaborators from other laboratories-- if you have an experiment for which our facilities would be particularly appropriate please let us know.

Edwin Kashy

P.S. Henry Blosser is now back as Laboratory Director after his sabbatical year.

TABLE I.--Sources of support for the MSU Cyclotron Laboratory for the fiscal year 1973-74.

Institution or Agency		Per Cent of total
National Science Foundation	Grant GP 27483 (experimental nuclear physics)	62.4
Atomic Energy Commission	Grant AT-11-1-1779 (nuclear chemistry)	8.8
National Science Foundation	Grant GP 40784 (theoretical nuclear physics)	4.8
Office of Naval Research	Contract N00014-68-A-0109-0008	3.3
Michigan State University		20.7

TABLE II.--List of faculty, research associates, and graduate students working at the MSU Cyclotron Laboratory in the period July 1, 1973-June 30, 1974 and their principal sources of support.

Professors	supported by	Present Address
Sam M. Austin	NSF-exp, MSU	
Walter Benenson	NSF-exp, MSU	
George F. Bertsch	NSF-theor, MSU	
Henry G. Blosser	NSF-exp, MSU	
Aaron I. Galonsky	NSF-exp, ONR, MSU	
Morton M. Gordon	NSF-exp, MSU	
Charles Gruhn		(on leave CERN, 72-75)
Edwin Kashy	NSF-exp, MSU	
Wm. H. Kelly	NSF-exp, MSU	
Wm. C. McHarris	AEC-chem, MSU	
Hugh McManus	NSF-theor, MSU	
B. H. Wildenthal	NSF-exp, MSU	
<u>Associate Professors</u>		
Jerzy R. Borysowicz	NSF-theor, MSU	
Gerard M. Crawley	NSF-exp, MSU	
Jerry A. Nolen, Jr.	NSF-exp, MSU	
<u>Assistant Professors</u>		
Fred M. Bernthal	AEC-chem, MSU	
Roger Markham	NSF-exp, MSU	
Hermann Nann	NSF-exp, BMFT (Germany)	
R.G.H. Robertson	NSF-exp, MSU	
Ray Warner	AEC-chem, MSU	
<u>Research Associates</u>		
John S. Boyno	NSF-exp, AEC-chem	
W. S. Chien	NSF-exp	
Paul S. Hauge	NSF-theor	Esso Prod., Houston
<u>Professors</u>		
Teng Lek Khoo	NSF-exp, AEC-chem	
Charles King	NSF-exp	
Kenneth Kosanke	AEC-chem	
Amnon Moalem	NSF-exp	
Donald Patterson	ONR	U. of Texas, Austin
Hermann Rosner	NSF-exp	
Lawrence Samuelson	NSF-exp, NAS-NIRA	
A. M. Shahabuddin	NSF-exp	
Shalom Shlomo	NSF-theor	
Shag-Fang Tsai	NSF-theor, MSU	
<u>Graduate Students</u>		
Wm. B. Chaffee	MSU-exp	Math.-Science Center, MSU
Wilton Chung	NSF-exp	
Robert R. Doering	ONR	Res. Assoc., MSU
Carol L. Dons	NSF-exp, AEC-chem	
Mike Edmiston	NSF-exp, AEC-chem	
Richard R. Firestone	NSF-exp, AEC-chem	
Kenneth Gilbert		Res. Assoc., MSU
Robert Gleitsmann	NSF-exp	
Jean Guile	NSF-exp	
A. Hadjicostis	NSF-exp	William & Mary College, VA.
Greg Hamilton	NSF-exp-theor	
G. Richard Hammerstein	NSF-theor	
Robert Howard		
(Computer Sci.)	NSF-exp	
Brian Jeltema	NSF-exp, AEC-chem	Berkeley, CA.
Steve Ewald	NSF-exp	Nucl. Eng., MSU
Felix Marti	NSF-exp	
Clare B. Morgan	NSF-exp	
Bing Poon	NSF-theor	
Lawrence Robinson	NSF-exp	Chicago
James A. Rice	NSF-exp	
David L. Show	NSF-exp	
Paul Smith	NSF-exp	
Wm. F. Steele	NSF-exp	
Karen Stricker	NSF-theor	
Wm. Wagner	NSF-exp	Bechtel Power, CA.
Herman White	NSF-exp	
Distasio, Marcello	AEC-chem	SIN, Villigen, Switzerland
John Collins	NSF-exp	

CONTENTS

I. Research in Progress

	Page		Page
1. <u>Exotic Reactions and Mass Measurements</u>		Multistep Processes in $^{186}\text{W}(p,d)^{185}\text{W}$, C. H. King, F. M. Bernthal, T. L. Khoo, J. A. Nolen, Jr., and J. Creasy.	32
Proton Rich Nuclei, D. Mueller, E. Kashy, W. Benenson, and H. Nann	1	Isospin Violations in (d,d') Reactions, P. A. Smith, G. M. Crawley, and J. A. Nolen	34
Second Mass Quartet in A=9 Nuclei, W. Benenson and E. Kashy	4	A Study of ^{12}C , ^{24}Mg , ^{40}Ca (^6Li), R. G. Markham and M.A.M. Shahabuddin	35
Mass of ^9Li , E. Kashy	5	A High-Spin State in ^{45}Ca , D. Mueller and E. Kashy	37
Observation of T=2 State in ^8B , R.G.H. Robertson and W. S. Chien.	6	5. <u>Neutron Work</u>	
Observation of T=2 States in ^8Li and ^8Be , R.G.H. Robertson, W. S. Chien, and D. R. Goosman	7	(p,n) Reactions in ^{48}Ca , ^{90}Zr , ^{120}Sn , and ^{208}Pb , R. R. Doering, Aaron Galonsky, and D. M. Patterson.	38
The Mass of ^{12}N , J. Nolen, M. Cantino, and F. Calaprice	8	$^{14}\text{C}(p,n)$ Reaction and the Tensor Force, Mike Cabot, Sam M. Austin, R. R. Doering, Aaron Galonsky, and D. M. Patterson	43
2. <u>Inelastic Scattering</u>		6. <u>Shell Model Calculations</u>	
High Resolution Inelastic Scattering, J. Nolen.	10	Empirical Hamiltonians for sd Shell Model Nuclei, B. H. Wildenthal, W. Chung, D. Larson and J. B. McGrory	44
Inelastic Proton Scattering from ^{140}Ce and ^{142}Nd at Ep=30 MeV, H. H. Rossner and S. M. Austin	11	The $f_{7/2}-d_{3/2}$ Model for the A=35-45 Region, B. H. Wildenthal	44
Development of the Mephisto Code, H. Rossner	13	Shell Model Calculations for the fp Shell Nuclei, D. H. Kong-A-Siou and B. H. Wildenthal.	45
3. <u>Transfer Reactions</u>		7. <u>Nuclear Astrophysics</u>	
Comparative Study of the (p, ^3He) and (p,t) Reactions on T=1/2 Nuclei in the 2s-1d Shell, H. Nann and B. H. Wildenthal.	14	Helium Burning Reactions in Stars (a) Measurements of $\Gamma_{\text{rad}}/\Gamma$ for the 7.66 MeV state of ^{12}C , R. Markham, S. M. Austin and M.A.M. Shahabuddin; (b) Precise values of E_x for the 7.66 MeV state of ^{12}C , J. A. Nolen and S. M. Austin	46
(α ,d) Reaction on Odd-A Nuclei in the 2s-1d Shell, W. S. Chien, B. H. Wildenthal, and H. Nann.	16	The Production of ^7Li in the $\alpha\alpha$ Reaction, C. H. King, H. H. Rossner, W. S. Chien, and S. M. Austin	48
Levels of ^{56}Ni , H. Nann and W. Benenson	18	8. <u>Giant Resonances</u>	
$^{64}\text{Ni}(p,t)$ Reaction at 40 MeV, D. H. Kong-A-Siou, H. Nann, and W. Benenson	20	Theory of Giant Resonances, G. Bertsch, S. Shlomo, and S. F. Tsai.	50
Spectroscopic Study of $^{60,61}\text{Ni}$ by (p,d) Reaction, D. H. Kong-A-Siou, W. S. Chien, and H. Rossner.	21	Decay Modes in the Giant Resonance Region of ^{40}Ca , A. Moalem, W. Benenson, G. Bertsch, G. M. Crawley and T. L. Khoo.	51
A Study of the (p,d) Reaction on the Germanium Isotopes, D. L. Show, B. H. Wildenthal and J. A. Nolen.	23	9. <u>Nuclear Gamma and Beta Spectroscopy</u>	
The Structure of ^{180}Ta , T. L. Khoo and C. H. King.	24	Odd-Parity Rotational-Band Structure in ^{48}V , L. E. Samuelson, W. H. Kelly, F. M. Bernthal, R. A. Warner, and Wm. C. McHarris.	53
$^{40}\text{Ar}(p,d)^{39}\text{Ar}$ Reaction, P. T. Debevec, W. S. Chien, R. E. Segel and J. Tonn	24	In-Beam Gamma Ray Investigations of Medium Mass Odd-Odd Nuclei, L. E. Samuelson, C. B. Morgan, M. F. Slaughter, J. A. Guile, R. A. Warner, William C. McHarris, T. L. Khoo, W. H. Kelly, E. M. Bernstein and R. Shamu	54
4. <u>Reaction Mechanisms</u>		Decay of N=79,81 Neutron Deficient Odd-Odd Rare Earths, R. B. Firestone, R. A. Warner, K. L. Kossanke, Wm. C. McHarris, and W. H. Kelly	59
Multistep Processes in the $^{26,24}\text{Mg}(p,t)$ $^{24,22}\text{Mg}$ Reactions, C. H. King, H. Nann, M.A.M. Shahabuddin and B. H. Wildenthal	25		
Higher-Order Processes in $^{22}\text{Ne}(p,t)$, W. S. Chien, C. H. King, H. Shahabuddin, and J. A. Nolen	27		
Search of Weak-Coupling Structure in (p,t) Results, H. Nann, B. H. Wildenthal, W. Benenson, K. K. Seth, and A. Saha	28		
(^3He , ^7Be) Studies from A=12 to 206, W. F. Steele and G. M. Crawley	30		

Page	Page		
The ϵ/β^+ and Delayed Proton Decay of ^{143}Gd , R. B. Firestone, R. A. Warner, K. L. Kossanke, Wm. C. McHarris, and W. H. Kelly.	60	Automatic Plate Scanner, J. Nolen and R.G.H. Robertson.	93
Anomalous K/L Capture Ratios, R. B. Firestone, R. A. Warner, Wm. C. McHarris, and W. H. Kelly	62	II. Abstracts of Talks at Meetings (July 1973-June 1974)	
Decay of 4.7-h ^{160}Ho to levels in ^{160}Dy , J. Wilczak, R. Dye, R. A. Firestone, F. M. Bernthal, and Wm. C. McHarris.	63	<u>Bloomington APS Meeting - November 1973</u>	
Quasiparticle States in Deformed Nuclei, T. L. Khoo, G. F. Bertsch, and G. Hamilton	64	Levels of ^{199}Hg Populated in ^{199}Tl Decay, G. J. Mathews and F. M. Bernthal	94
High K 2- and 4- Quasiparticle States in ^{174}Hf and ^{176}Hf , T. L. Khoo, F. M. Bernthal, J. S. Boyno, and R. A. Warner.	65	Study of Giant Resonances in ^{16}O by ^3He Scattering, A. Moalem, W. Benenson and G. M. Crawley.	94
On Setting Limits to the Hexadecapole Deformations in W and Os Nuclei from Perturbed Rotational Band Structure, F. M. Bernthal, D. B. Jeltama, J. S. Boyno, T. L. Khoo, and R. A. Warner	66	The ($^3\text{He}, ^6\text{He}$) Reaction on Light Nuclei, W. Benenson, E. Kashy, A. Moalem and H. Nann.	94
Decoupled $i_{13/2}$ Neutrons and Backbending in Rare-Earth Nuclei, F. M. Bernthal, J. S. Boyno, T. L. Khoo, and R. A. Warner.	67	Helium Jet Recoil Transport Utilizing Plasma Chemistry, K. L. Kossanke, M. Slaughter, M. Edmiston, and Wm. C. McHarris	94
Levels of ^{177}W and ^{178}W , C. Dors, F. M. Bernthal, T. L. Khoo and C. King.	69	Recent Experience with Momentum Matching and Dispersion Matching Techniques in the MSU Magnetic Spectrograph, R. J. Gleitsmann, G. Hamilton, and J. A. Nolen, Jr.	94
Levels in ^{182}W , B. D. Jeltama, F. M. Bernthal, T. L. Khoo, and C. L. Dors	70	Lane Model Consistent Macroscopic Analysis of (p,n) Reactions to the Isobaric Analog States of ^{48}Ca , ^{90}Zr , ^{120}Sn , and ^{208}Pb at 25, 35, and 45 MeV, D. M. Patterson, R. R. Doering, and A. I. Galonsky	94
Rotational Bands in ^{183}Os , C. Dors, F. M. Bernthal, and R. A. Warner.	72	$^{40}\text{Ca}(p,p')$ at 35 MeV, J. A. Nolen, Jr., R. J. Gleitsmann, G. Hamilton, A. Moalem, and T. Udagawa	95
High Spin Level Structure in Pt Nuclei from $\text{Os}(\alpha, xn\gamma)$ Reactions, J. C. Cunnane, M. Piiparinen, P. J. Daly, F. M. Bernthal, C. L. Dors, and T. L. Khoo.	74	A Measurement of the Excitation Energy of the 7.65 MeV Level of ^{12}C , G. Hamilton, J. A. Nolen, Jr., and D. Tody	95
10. <u>Accelerator Design</u>		Energy Dependence of the Isospin-Exchange Term of the Effective Two-Nucleon Interaction, R. R. Doering, D. M. Patterson, and Aaron Galonsky	95
Design Studies of Superconducting Heavy Ion Cyclotrons, H. G. Blosser, M. M. Gordon, and D. A. Johnson	75	Levels of ^{187}Os Populated in the $^{186}\text{W}(\alpha, 3n)$ Reaction, J. S. Boyno, F. M. Bernthal, T. L. Khoo and R. A. Warner	95
Orbit Properties of Ions in a Migma Fusion Device, M. M. Gordon and D. A. Johnson	77	Recoil Effects in Single-Nucleon Transfer Reactions, P. Hauge and G. Bertsch.	95
11. <u>Technical Developments</u>		Progress Report on the MSU Automated Plate Scanner, R.G.H. Robertson and J. A. Nolen, Jr.	95
Cyclotron Improvements, P. S. Miller, H. G. Blosser, H. Hilbert, E. Kashy, D. Magistro, P. Marchand and G. Stork	78	$^{40}\text{Ar}(p,n)$ Reaction to the Isobaric Analog State (IAS) and Anti-Analog State (AAS) in ^{40}K , Aaron Galonsky, J. G. Branson, R. R. Doering, and D. M. Patterson.	96
A Pulse Generator for Slow Beam Pulsing, J.-F. P. Marchand and T. L. Khoo.	80	New Orbit Codes for the Indiana Cyclotron, M. M. Gordon and D. A. Johnson	96
Position-Sensitive Proportional Counter Development, R. G. Markham and R.G.H. Robertson	82	Backbending and Forking in ^{182}W , B. D. Jeltama and F. M. Bernthal	96
A Counter Telescope with Two Dimensional Position Sensitivity, R. Markham, S. Austin and H. Laumer.	84	Study of the $^{29}\text{Si}(p,t)^{27}\text{Si}$ and $^{29}\text{Si}(p, ^3\text{He})^{27}\text{Al}$ Reaction, H. Nann, W. Benenson and W. A. Lanford	96
Progress on the MSU Time-of-Flight Spectrometer and Helium-Impurity Thermalizer-Transport, M. D. Edmiston, K. L. Kossanke, Wm. C. McHarris, R. A. Warner, and W. H. Kelly.	86	Levels of ^{182}Re , M. F. Slaughter, R. A. Warner, W. H. Kelly, and Wm. C. McHarris.	96
Helium-Jet Recoil Transport System, K. L. Kossanke, M. D. Edmiston, Wm. C. McHarris, R. A. Warner and W. H. Kelly	88	<u>Chicago APS Meeting - February 1974</u>	
Target Making Laboratory, J. Nolen, H. Raut and D. Tody	90	Structure of ^{32}S from $^{33}\text{S}(p,d)^{32}\text{S}$, D. L. Show, A. S. Moalem, and B. H. Wildenthal.	96

Page	Page		
The Level Structure of ^{174}Hf from (α, xn) Reactions, T. L. Khoo, F. M. Bernthal, J. S. Boyno and R. A. Warner	97	Isobaric Mass Quartets in the Mass-21 and Mass-37 Nuclei, W. Benenson, E. Kashy, and I. D. Proctor	102
Proton Rich Exotic Nuclei, W. Benenson.	97	Shell-Model Study of ^{24}Ne , R.G.H. Robertson and B. H. Wildenthal	103
High Spin Level Structure in ^{192}Pt , P. J. Daly, J. C. Cunnane, M. Piiparinen	97	Production of the Light Elements Lithium, Beryllium, and Boron by Proton-Induced Spallation of ^{14}N , Helmut Laumer, Sam M. Austin, Lolo M. Panggabean, and Cary N. Davids	104
A=9 Isospin Quartet, E. Kashy, W. Benenson and J. A. Nolen, Jr..	97	High-Resolution Study of $^{48}\text{Ca}(p,t)^{46}\text{Ca}$ at $E_p=39$ MeV, G. M. Crawley, P. S. Miller, G. J. Igo and J. Kulleck	105
Levels of ^{56}Ni , W. Benenson and H. Nann	97	Isospin Mixing from the Effective Nucleon Interaction, G. F. Bertsch and B. H. Wildenthal.	106
Super Conducting Magnets for Heavy-Ion Cyclotrons, H. G. Blosser, M. M. Gordon and D. A. Johnson.	97	Shell-Model Calculations for A=6-14 Nuclei with a Realistic Interaction, Paul S. Hauge, and S. Maripuu	107
Elasticity and Nuclear Vibrations, G. F. Bertsch	98	Mass of ^{31}S , A. Moalem and B. H. Wildenthal.	108
Four Quasiparticle States in ^{174}Hf and ^{176}Hf , T. L. Khoo, F. M. Bernthal, J. S. Boyno and R. A. Warner	98	High-Resolution Study of the Particle-Hole Multiplets in ^{208}Bi , G. M. Crawley, E. Kashy, W. Lanford and H. G. Blosser.	109
The Excitation of Multipole Resonances with Electron and Hadron Scattering, G. R. Hammerstein, H. McManus and A. Moalem	98	35-MeV Proton Inelastic Scattering from Low-Lying States in ^{207}Pb , W. T. Wagner, G. R. Hammerstein, G. M. Crawley, J. R. Borysowicz, and F. Petrovich.	110
Evidence for Rotational Structure in ^{48}V , L. E. Samuelson, F. M. Bernthal, W. H. Kelly, and Wm. C. McHarris	98	β decay of ^{22}F , Cary N. Davids, David R. Goosman, G. Guillaume, D. H. Wilkinson, and W. A. Lanford	111
The Decay of ^{199m}Pb , M. W. Johnson, Wm. C. McHarris, R. A. Warner and W. H. Kelly.	98	Fermi beta decay: The Masses of ^{22}Mg , ^{26}Si , ^{30}S , and ^{34}Ar , J. C. Hardy, H. Schmeing, W. Benenson, G. M. Crawley, E. Kashy, and H. Nann.	112
Rotational Bands in ^{183}Os , C. L. Dors, F. M. Bernthal, B. D. Jeltema, and R. A. Warner	98	Capillary Waves in a Quantum Liquid, George F. Bertsch.	113
The Odd-Odd Nucleus ^{116}Sb : State Energies and Spins, C. B. Morgan, J. A. Guile, R. A. Warner, L. E. Samuelson, Wm. C. McHarris, W. H. Kelly, E. M. Bernstein and R. Shamu.	99	$^{207}\text{Pb}(p,d)^{206}\text{Pb}$ Reaction and Some Matrix Elements of the Effective Interaction, W. A. Lanford and G. M. Crawley.	114
The Low-Lying Levels and an Isomeric State of ^{118}Sb , W. B. Chaffee, C. B. Morgan, R. A. Warner, Wm. C. McHarris, W. H. Kelly, E. M. Bernstein and R. Shamu	99	Inelastic Proton Scattering from ^{138}Ba and ^{144}Sm at 30 MeV, Duane Larson, Sam M. Austin, and B. H. Wildenthal	115
Multistep Processes in $^{186}\text{W}(p,d)$ at 35 MeV, C. H. King, F. M. Bernthal, T. L. Khoo and J. A. Nolen, Jr.	99	Neutron-Deficient Isotopes ^{64}Ge and ^{65}Ge , R.G.H. Robertson and Sam M. Austin.	116
^{12}C , $^{24}\text{Mg}(\alpha, ^6\text{Li})$ at 46 MeV, R. G. Markham.	99	Isobaric Mass Quartets in A=33 Nuclei, H. Nann, W. Benenson, E. Kashy and P. Turek.	117
Comparisons of the Mirror Reactions $^6\text{Li}(d,p_1)^7\text{Li}^*$ -- $^6\text{Li}(d,n_1)^7\text{Be}^*$ and $^{16}\text{O}(d,p_1)^{17}\text{O}^*$ -- $^{16}\text{O}(d,n_1)^{17}\text{F}$, S. M. Austin, R. L. Hershberger, F. Riess and R. S. Simon	99	A=9 Isospin Quartet, E. Kashy, W. Benenson, and J. A. Nolen, Jr.	118
Fast Chemistry On-Line with a Helium-Jet Recoil-Transport System, K. L. Kusanke, M. Edmiston, M. Slaughter, Wm. C. McHarris, and W. H. Kelly	99	T=3/2 States in Mass-11 Nuclei, W. Benenson, E. Kashy, D. H. Kong-A-Siou, A. Moalem, and H. Nann	119
The $^{154}\text{Sm}(^4\text{He}, ^6\text{He})^{152}\text{Sm}$ Reaction, J. S. Boyno, W. Benenson, T. L. Khoo, C. H. King, Wm. C. McHarris and R. A. Warner.	100	Configuration Mixing of Two-Quasiparticle States in Even-Even Deformed Nuclei, H. Massmann, J. O. Rasmussen, T. E. Ward, P. E. Haustein and F. M. Bernthal	120
Progress on the MSU On-Line Mass Identification System, K. L. Kusanke, M. Edmiston, Wm. C. McHarris, and W. H. Kelly.	100	Searth for a γ -Branch from Shape Isomers in ^{236}U and ^{238}Np , J. Borggreen, J. Hattula, E. Kashy and V. Maarbjerg.	121
III. Title Page of Published Papers (July 1973-June 1974)		Nuclear Spectroscopic Studies of ^{252}Es , P. R. Fields, I. Ahmad, R. F. Barnes R. K. Sjoblom and Wm. C. McHarris	122
1. Journals		Shell Model Calculations for Masses 27, 28, and 29: Specific Application to $^{27,28}\text{Mg}$ and $^{28,29}\text{Al}$, M.J.A. De Voigt and B. H. Wildenthal.	123
β^+ Decay of ^{20}Na , D. F. Torgerson, K. Wien, Y. Fares, N. S. Oakley, R. D. Macfarlane, and W. A. Lanford.	101		

	Page		Page
Electron and Proton Inelastic Scattering from ^{40}Ca , ^{120}Sn , and ^{208}Pb , G. R. Hammerstein, R. H. Howell and F. Petrovich	124	2. <u>Conference Proceedings</u>	
The Error Operator and its Eigenvectors in Electron Scattering, J. H. Hetherington and J. Borysowicz.	125	Systematics of "Backbending" Phenomena in the Yrast Bands of $^{182-188}\text{Os}$ and other Deformed Nuclei, F. M. Bernthal, R. A. Warner, T. L. Khoo, and J. S. Boyno	143
Recoil Corrections for Single-Nucleon Transfer Reactions, Paul S. Hauge	126	Low-Lying States of ^{48}V from the $^{48}\text{Ti}(p,n)$ Reaction, L. E. Samuelson, W. H. Kelly, R. A. Warner, Wm. C. McHarris, E. M. Bernstein, and R. Shamu	144
Nuclear Response Function, G. F. Bertsch	127	The Tensor Part of the Effective Interaction from $\text{N}^{14}(p,p')$, Sam M. Austin and S. H. Fox	145
Excitation of Giant Resonances by Inelastic ^3He Scattering, A. Moalem, W. Benenson, and G. M. Crawley	128	(p,t) Reactions on Odd-A Nuclei and the Core-Excitation Model, Kamal K. Seth, A. K. Saha, W. Stewart, W. Benenson, W. Lanford, and B. H. Wildenthal	146
Experimental Demonstration of Backbending Behavior from a Band Crossing in ^{154}Gd , T. L. Khoo, F. M. Bernthal, J. S. Boyno, and R. A. Warner	129	Study of the ($^3\text{He},p$) Reaction on the Si-Isotopes, H. Nann, U. Friedland, B. Hubert, H. H. Duhm, H. Hafner, and B. H. Wildenthal.	147
Backbending and Forking in the Yrast States of Even Os Isotopes, R. A. Warner, F. M. Bernthal, J. S. Boyno, T. L. Khoo and G. Sletten	130	Observation of the Giant Quadrupole State by High Energy Inelastic ^3He Scattering, G. M. Crawley, W. Benenson and A. Moalem.	148
Prediction of Weak-Coupling Structure from a Shell-Model Basis, B. H. Wildenthal, H. Nann and Kamal K. Seth	131	Exploring $Z>N$ Nuclei with Multinucleon Transfer Reactions, W. Benenson and E. Kashy	149
Highly Proton-Rich $T_z=2$ Nuclides: ^8C and ^{20}Mg , R.G.H. Robertson, S. Martin, W. R. Falk, D. Ingham and A. Djaloelis	132	Back-Bending Phenomena in ^{154}Gd and $^{182-188}\text{Os}$, T. L. Khoo, R. A. Warner, F. M. Bernthal and J. S. Boyno	150
(p,t) Reactions on Odd-A Nuclei and the Weak-Coupling Core-Excitation Model, K. K. Seth, A. Saha, W. Stewart, W. Benenson, W. A. Lanford, H. Nann and B. H. Wildenthal	133	The $^{154}\text{Sm}(\alpha, ^6\text{He})^{152}\text{Sm}$ Reaction, J. S. Boyno, W. Benenson, T. L. Khoo, C. H. King, Wm. C. McHarris and R. A. Warner.	151
The Excitations of Giant Resonances in Electron and Positron Scattering, G. R. Hammerstein, H. McManus A. Moalem, and T.T.S. Kuo	134	Helium Jet Recoil Transport Method Used for Studying Nuclides Far from Beta Stability, K. L. Kossanke, M. Edmiston, R. Firestone, R. A. Warner, F. M. Bernthal, Wm. C. McHarris and W. H. Kelly	152
Two-Neutron Pickup Strengths of the Even Lead Isotopes the Transition from Single-Particle to "Collective", W. A. Lanford and J. B. McGrory.	135	IV. Abstracts of Papers in Press (after June 30, 1974)	
Coulomb Energy Shifts of the Ground States of A=18 and A=42 Nuclei, S. Shlomo and G. F. Bertsch	136	Study of the (p, ^3He) and (p,t) Reactions on ^{29}Si , H. Nann, W. Benenson, W. A. Lanford and B. H. Wildenthal.	153
How Good is the Collective Model?, G. Bertsch and S. F. Tsai	137	Fast Calibration of Large Si(Li) Electron Detectors from 511.0 to 4564.0 keV Using Double-Escape Peaks and Compton Edges from ^{66}Ga , R. B. Firestone, R. A. Warner, Wm. C. McHarris, and W. H. Kelly	153
Fast Aqueous Chemistry On-Line with Cyclotron-Produced Activities Using a Helium-Jet Recoil-Transport System, K. L. Kossanke, Wm. C. McHarris, R. A. Warner and W. H. Kelly	138	Decay of ^{177}Ta to Levels in ^{177}Hf , B. D. Jeltama and F. M. Bernthal	153
Measuring Nuclear Excitation Energies and Q-Values with a Cyclotron-Magnetic Spectrograph System, J. A. Nolen, Jr., G. Hamilton, E. Kashy and I. D. Proctor.	139	Study of the $^{30}\text{Si}(^3\text{He},p)^{32}\text{P}$ Reaction, H. Nann, U. Friedland, B. Hubert, W. Patscher and B. H. Wildenthal	154
Autoradiographic Localization of ^{13}N after Fixation of ^{13}N -Labeled Nitrogen Gas by a Heterocyst-Forming Blue-Green Alga, C. Peter Wolk, Sam M. Austin, John Bortins, and Aaron Galonsky.	140	A Study of the Nuclear Structure of ^{36}Cl with the (p,d) Reaction, J. A. Rice, B. H. Wildenthal and B. M. Freedom.	154
A Shell-Model Calculation for Masses 15, 16, and 17, B. S. Reehal, and B. H. Wildenthal	141	The $^{39}\text{K}(p,d)^{38}\text{K}$ Reaction at $E_p=35$ MeV, B. H. Wildenthal, J. A. Rice, and B. M. Freedom.	155
Energy Multiplication by Beam Recycling in an Isochronous Cyclotron, E. D. Hudson, M. L. Mallory, R. S. Lord, A. Zucker, H. G. Blosser and D. A. Johnson	142	A High Resolution Study of ^{208}Pb with 35 MeV Protons, W. T. Wagner, G. M. Crawley, G. R. Hammerstein, and H. McManus	155
		A High Resolution Study of ^{40}Ca Via Inelastic Proton Scattering at 35 MeV, J. A. Nolen, Jr. and R. J. Gleitsmann.	155

	Page		Page
Study of ^{173}Hf Levels Populated in the Decay of ^{173}Ta , I. Rezanka, I. M. Ladenbauer-Bellis, T. Tamura, W. B. Jones and F. M. Bernthal	156	Discovery of the Missing Two-Particle, Two-Hole 0^+ States in ^{40}Ca , Kamal K. Seth and A. Saha.	161
States in $N=81$ ^{141}Ng Populated by the Decay of ^{141}Pm , F. Y. Yap, R. R. Todd, W. H. Kelly, Wm. C. McHarris, and R. A. Warner	156	Study of the Structure of ^{62}Zn and ^{64}Zn Through (p,t) Reactions at 35 MeV, R. A. Hinrichs and D. M. Patterson.	162
Nuclear Isomers and What They Can Teach Us, Wm. C. McHarris	157	Two-Body Short-Range Correlations and Coulomb Matrix Elements, G. F. Bertsch	162
An Energy-Dependent, Lane-Model, Nucleon-Nucleus Optical Potential, D. M. Patterson R. R. Doering, and Aaron Galonsky	157	Levels of ^{56}Ni , H. Nann and W. Benenson	163
A Study of the Nuclear Continuum in ^{16}O by Inelastic ^3He Scattering, A. Moalem, W. Benenson, and G. M. Crawley	157	High Resolution (p,p') on ^{207}Pb and ^{209}Bi , W. T. Wagner, G. M. Crawley and G. R. Hammerstein	163
A Microscopic Description of IAS Transitions Induced by 25-, 35-, and 45-MeV Protons, R. R. Doering, D. M. Patterson, and Aaron Galonsky.	157	V. Ph.D. Thesis Titles (July 1973-June 1974)	
Basic Orbit Properties of Ions in a Migma Fusion Device, M. M. Gordon and D. A. Johnson	158	Department of Physics	164
An Ultra-Thin-Window Gas Cell, Helmut Laumer, Cary N. Davids, Sam M. Austin, and Lolo M. Panggabean	158	Department of Chemistry	164
Cross Sections for the Production of Mass-6 and Mass-7 Nuclides in the Proton-Induced Spallation of ^{20}Ne , Lolo M. Panggabean, Sam M. Austin, and Helmut Laumer	158		
First Excited A=9 Isospin Quartet, W. Benenson and E. Kashy	158		
Decays of the $f_{7/2}$ Isomers, ^{53}gFe and $^{53\text{m}}\text{Fe}$, J. N. Black, Wm. C. McHarris, W. H. Kelly and B. H. Wildenthal.	159		
Techniques for the Study of Short-Lived Nuclei, Ronald D. Macfarlane and Wm. C. McHarris.	159		
Focusing Properties of Superconducting Cyclotron Magnets, H. G. Blosser and D. A. Johnson	159		
A Note on Discrepancies Between (p,n) and (p,np) Reactions on Nuclei near A=208, G. M. Crawley, P. S. Miller, R. Doering, Aaron Galonsky and D. Patterson	160		
Hexadecapole Deformations in W and Os Nuclei from Perturbed Rotational Band Structure, F. M. Bernthal, B. D. Jeltama, J. S. Boyno, T. L. Khoo, and R. A. Warner	160		
Rotational Band Structure in $N=105$ and 107 Isotones: I. Evidence for the Transition to $ IRj\rangle$ Coupling at High Spins in ^{179}W , F. M. Bernthal and R. A. Warner	160		
J-Dependence Observed in $^{61,62}\text{Ni}(p,d)$ Reactions at 40 MeV, D. H. Kong-A-Siou and W. S. Chien	160		
Failure of the Allowed Assumption in the ϵ/β^+ Decays of ^{145}Gd and ^{143}Gd - Experimental Evidence for Interference Effects in Nuclear β Decay, R. B. Firestone, R. A. Warner, Wm. C. McHarris, and W. H. Kelly.	161		
Classical View of the Application of Sum Rules to Inelastic Form Factors, G. F. Bertsch	161		