

ANNUAL REPORT
of the
MICHIGAN STATE UNIVERSITY
CYCLOTRON LABORATORY*
for the period
July 1, 1969 to July 1, 1970

by
Project Staff

September 1970
East Lansing, Michigan

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FOREWARD

As in past years our Annual Report consists primarily of reprints of published research articles from the Michigan State University Cyclotron Laboratory for the period July 1, 1969 through June 30, 1970. In addition abstracts of papers presented at meetings or submitted for publication but not yet published (October 1970) are included, as well as a list of faculty and students working at the laboratory as of September 1970 and the thesis topics of students who completed their Ph.D. work in the year 1969-70.

The year 1969-70 was again a period of high productivity for the laboratory. The number of publications was somewhat larger than the record number of the previous year even though the size of the staff was somewhat smaller. Scientifically, the program of developing the (p,p') reaction as a reliable spectroscopic tool is now producing handsome dividends; nuclear structure information is flowing from this program at an impressive rate. In addition the broad range spectrograph has come into a state of rather full use and very precise data ranging from inelastic scattering at 1 in 10^4 resolution to very precise mass determination on relatively inaccessible nuclei (using the ^3He , ^6He reaction and a novel absolute calibration system). Other programs cover a broad spectrum of activities from study of isospin phenomena to nuclear astrophysics to development of a high resolution neutron facility, etc.

As regards to the faculty we are exceedingly pleased that Professor Jerry Nolen formerly of the University of Maryland has recently joined our staff, filling a position provided by the National Science Foundation Science Development program, and that there have been no resignations in the year. On the other hand the number of Research Associates and Graduate Research Assistants is down from previous years, the decrease being forced by severely strained budgets. At the same time we are pleased that our finishing graduate students have all managed to find jobs even in these difficult times. We believe this achievement in substantial part attests to the value of the broadly based training which the laboratory gives it's students. (The total number of students who have completed the Ph.D. program and found positions since July 1969 is now 10 which includes 6 finishing after the June 1970 cutoff date for the list of theses in Section IV.)

In reading from the foreward of last year's Annual Report I note that I concluded with the sentences "... the level of activity is high, and the program is exciting and pursued with much enthusiasm on the part of all concerned. The laboratory looks forward to continued stimulating research and training activity in the approaching year." These words still seem an accurate description of the MSU Cyclotron Laboratory in the fall of 1970. The general pessimism which exists in many parts of the physics community seems at present not

to be found here, even though financial problems have compelled us to take a number of painful steps in trimming various portions of the program. Indeed, the basic enthusiasm and optimism of our staff is one of the most valued characteristics of this laboratory—our students still have the chance to see and participate in some of the real joy and excitement of science and we are thankful for that. We are moreover all dedicated to preserving this energizing atmosphere of free inquiry and as we succeed in that objective we shall also undoubtedly succeed in maintaining a high level of productivity in our future research and training roles.

H. Blosser

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Evidence for a Tensor Effective Two-Body Interaction in the $^{14}\text{N}(p,p')$ 2.31 MeV Excitation, G.M. Crawley, S.M. Austin, W. Benenson, V.A. Madsen, F.A. Schmittroth, and M.J. Stomp, Physics Letters Vol. <u>32B</u> , 92(1970).	2
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Neutron-Deficient Members of the A=139 Decay Chain. II. 4.5-h Pr^{139} , D.B. Beery, W.H. Kelly, and Wm.C. McHarris, Phys. Rev. <u>188</u> , 1875(1969).	16
Neutron-Deficient Members of the A=139 Decay Chain. I. 5.5-h Nd^{139m} and 30-min Nd^{139g} , D.B. Beery, W.H. Kelly, Wm.C. McHarris, Phys. Rev. <u>188</u> , 1851(1969).	22
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Nuclear Surface and Inelastic Proton Scattering, C.R. Gruhn, B.M. Freedom, K. Thompson, Phys. Rev. Letters <u>23</u> , 1175(1969).	65
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An Energy Calibration Method for Beam Analyzer-Magnetic Spectrograph Combinations, G.F. Trentelman and E. Kashy, Nuc. Instr. and Methods <u>82</u> , 304(1970).	76
Analysis of Isochronous Cyclotrons with Separated Hard-Edge Magnets, M.M. Gordon, Nuc. Instr. and Methods <u>83</u> , 267(1970).	79

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Three-Quasiparticle Multiplets in Nuclei Below $N=82$, D.B. Beery, R. Muthukrishnan, and W.H. Kelly, August 1969 Proceedings of International Conference on Properties of Nuclear States, Montreal, Canada.	96
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II. Talks given at Meetings (July 1969-June 1970)	
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Levels of ^{135}I from $^{136}\text{Xe}(d,^3\text{He})^{135}\text{I}$, B.H. Wildenthal, E. Newman, and R.L. Auble, Bull. Am. Phys. Soc. <u>14</u> , 1239(1969).	218
Properties of the ^{209}Bi Ground State Analogue in ^{209}Po , G.M. Crawley, W. Benenson, D.L. Bayer, P.S. Miller, R. St.Onge, and A. Kromminga, Bull. Am. Phys. Soc. <u>14</u> , 1209(1969).	219
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Measurements of the Isotopes Effect on the Diffusion Constant of Lithium in Germanium, E. Dounce, C.R. Gruhn, and P.D. Fisher, Bull. Am. Phys. Soc. <u>15</u> , 555(1970).	228
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The $\text{Mg}^{24,26}(p,\alpha)\text{Na}^{21,23}$ Reactions at 35 MeV, G.C. Morrison, R.C. Bearnse, W. Pickles, and E. Kashy, Bull. Am. Phys. Soc. <u>15</u> , 544(1970).	231
Study of States in ^{33}S , ^{34}Cl , and ^{36}Cl with the (p,d) Reaction, B.H. Wildenthal, G.M. Crawley, and W. McLatchie, Bull. Am. Phys. Soc. <u>15</u> , 484(1970).	232
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Improving the Energy Resolution and Duty Factor of Isochronous Cyclotrons, M. M. Gordon.

Experimental Studies of the Deficient Gadolinium Isotopes II. $\text{Gd}^{145\text{m}}$, R.E. Eppley, W.C. McHarris, and W.H. Kelly.

States in Odd-Odd Tl^{200} Populated by the Electron Capture Decay of Pb^{200} , R.E. Doebler, W.C. McHarris, and W.H. Kelly.

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Straightforward Elucidation of Complex Shell-Model States by the β Decay of Nuclei Far from Stability, Wm.C. McHarris, R.E. Eppley, R.A. Warner, R.R. Todd, and W.H. Kelly.

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