

Section II  
Abstracts of Oral Papers  
July 1969-June 1970

Abstract Submitted

For the Boulder, Colorado Meeting of  
The American Physical Society

Oct. 30, 31 & Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 55.2

Atomic Weight = 135  
Nuclear Reaction:  
One-nucleon transfer

Levels of  $^{135}\text{I}$  from  $^{136}\text{Xe}(d, ^3\text{He})^{135}\text{I}$ .\*

B. H. WILDENTHAL, Michigan State University,  
and E. NEWMAN and R. L. AUBLE, Oak Ridge Nat.  
Lab.--We have extended our study of the N=82  
isotones to the lightest member of the chain  
which can be studied with current experimental  
techniques. A target of Xe gas, enriched to  
95%  $^{136}\text{Xe}$ , was bombarded with 40.2 MeV deuterons  
from the ORIC and the  $^3\text{He}$  spectrum, corresponding  
to the formation of  $^{135}\text{I}$ , was observed with  
standard solid state detector apparatus. The  
ground state Q-value of the  $^{136}\text{Xe}(d, ^3\text{He})^{135}\text{I}$   
reaction was found to be  $-4.438 \pm 0.030$  MeV, and  
excited states of  $^{135}\text{I}$  were observed at  $0.590 \pm$   
 $0.030$  and  $0.860 \pm 0.030$  MeV excitation. The ground  
state is characterized by an  $\ell=4$  angular dis-  
tribution and the excited states each have  $\ell=2$   
distributions. The observed experimental fea-  
tures can be understood in terms of a shell  
model<sup>1</sup> built upon the  $1g_{7/2}$  and  $2d_{5/2}$  orbits.

\*Work supported in part by the U.S. Atomic  
Energy Commission.

<sup>1</sup>B. H. Wildenthal, Phys. Rev. Lett. 22, 1118  
(1969).

Abstract Submitted

For the Boulder, Colorado Meeting of

The American Physical Society

Oct. 30, 31 & Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 55.5

Atomic Weight = 209  
Charged Particle  
Reactions

Properties of the  $^{209}\text{Bi}$  Ground State  
Analogue in  $^{209}\text{Po}$ .\* G. M. CRAWLEY, W. BENENSON,  
D. L. BAYER, P. S. MILLER, and R. ST. ONGE, Michigan  
State Univ. and A. KROMMINGA, Calvin College.--  
The analogue of the ground state of  $^{209}\text{Bi}$  was  
investigated by both the  $^{209}\text{Bi}(p,n)^{209}\text{Po}$  and  
the  $^{209}\text{Bi}(pn\bar{p})^{208}\text{Bi}$  reactions. Neutron spectra  
were taken at  $0^\circ$  with a time resolution of about  
1 nanosec. The proton decay of the analogue  
state to the low lying multiplets in  $^{208}\text{Bi}$  was  
also observed. In this case the protons were  
detected in a dE-E counter telescope at labora-  
tory angles of  $90^\circ$ ,  $120^\circ$  and  $160^\circ$  and at energies  
from 24 to 30 MeV. The coulomb energy difference  
 $^{209}\text{Po}-^{209}\text{Bi}$  was measured as  $18.88 \pm 0.07$  MeV and  
the width of the analogue state was shown to be  
about 200 keV. Calculations of the proton de-  
cay widths will be discussed.

\*Work supported in part by the National Science  
Foundation.

Abstract Submitted

For the Boulder, Colorado Meeting of

The American Physical Society

Oct. 30, 31 & Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 54.5

Atomic Weight = 48  
Nuclear Reactions:  
Inelastic Proton  
Scattering

Energy Dependence of Inelastic Proton Scattering from  $^{48}\text{Ca}$ .\* C. J. MAGGIORE, C. R. GRUHN, T. Y. T. KUO, B. M. PREEDOM, Michigan State University.--Angular distributions of protons inelastically scattered from  $^{48}\text{Ca}$  have been obtained at four energies (25.11, 29.83, 35.00, and 40.22 MeV) using the proton beam from the MSU sector-focused cyclotron. The scattered protons were detected with Ge(Li) counters fabricated at this laboratory. Typically, the overall energy resolution was 30 keV (FWHM). The angular distributions were taken between  $12.5^\circ$  and  $100^\circ$  in  $5^\circ$  increments. The target was an isotopically enriched (96%)  $^{48}\text{Ca}$  foil. The energy dependence of the angular distributions for the states observed below the (p,d) threshold will be discussed. The  $4.28(0^+)$  excited state was not observed, however an upper limit for exciting this state was obtained at each energy. The results of preliminary DWBA calculations will also be presented.

\* Work supported in part by the National Science Foundation.

Abstract Submitted

For the Boulder, Colorado Meeting of

The American Physical Society

Oct. 30, 31 & Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 54.5

Atomic Weight = 40  
Nuclear Reaction:  
Inelastic Proton  
Scattering

Energy Dependence of Inelastic Proton  
Scattering from  $^{40}\text{Ca}$ .\* T. Y. T. KUO, C. R.  
GRUHN, B. M. FREEDOM, and C. J. MAGGIORE, Mich-  
igan State Univ.--Inelastic proton scattering  
on  $^{40}\text{Ca}$  has been studied at 24.930, 30.040,  
34.780 and 39.830 MeV incident energies. The  
spectra were obtained using surface-barrier  
Ge(Li) detectors with typically 30 keV overall  
resolution (FWHM). The  $0^+$  first excited state  
(3.35 MeV) was observed at each energy from  $27^\circ$   
to  $97^\circ$  with peak cross-sections on the order of  
50-100  $\mu\text{b}/\text{sr}$ . Angular distribution for this as  
well as 20 other states with excitation energies  
up to 8.87 MeV have been obtained. A comparison  
of the angular distributions for a given state  
indicates a systematic change in the magnitude  
and slope of the differential cross-section as  
the energy varies. The energy dependence of the  
angular distributions will be presented and dis-  
cussed in terms of present reaction theories.

\*Work supported in part by the National Science  
Foundation.

Abstract Submitted

For the Boulder, Colorado Meeting of

The American Physical Society

Oct. 30, 31 & Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 50

Nuclear  
Instrumentation

The MSU Cyclotron Sigma-7 Project.\* W. BENENSON, R. A. DEFOREST, R. F. AU, D. L. BAYER, and W. E. MERRIT, Michigan State Univ.--The present status of the MSU time-sharing computer system is discussed. The computer is a Scientific Data System Sigma-7 with 32K, 32 bit words with two rapid access discs, memory map, memory protection hardware and standard input output peripherals. The computer runs under an MSU supervisor called JANUS<sup>1</sup> which is being replaced by JANUS II. At present the computer can be used by many Physicists simultaneously for a variety of purposes including several on-line data taking tasks and large (up to 128K words) FORTRAN programs. JANUS II will provide a file management system and more efficient allocation of time to off-line users. Computer control of the cyclotron and a multipurpose scattering chamber is in the final stages of construction and testing.

\*Work supported in part by the National Science Foundation.

<sup>1</sup>J. O. Kopf & P. J. Plauser, Fall Joint Computer Conf. 1968, page 1033.

Abstract Submitted

For the Boulder, Colorado Meeting of

The American Physical Society

Oct. 30, 31 & Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 54.8

Atomic Weight = 42  
Charged Particle  
Reactions

Negative Parity Levels in  $^{42}\text{Ca}$ .\* R. SHERR†, G. CRAWLEY, and W. BENENSON, Michigan State Univ.--Negative parity states in  $^{42}\text{Ca}$  may have 3 particle -1 hole configurations, with  $T(\text{particles})=1/2$  or  $3/2$ . The reaction  $^{43}\text{Ca}(^3\text{He},\alpha)^{42}\text{Ca}$  investigated by Alford et.al. should populate  $T_p=3/2$  states. The triton transfer reaction  $^{39}\text{K}(\alpha,p)^{42}\text{Ca}$  should preferentially populate states with  $T_p=1/2$ , assuming that the  $^{39}\text{K}$  configuration is  $d_{3/2}$ . Measurements with 29.5 MeV  $\alpha$ -particles showed that, of the ten known negative parity levels below 5.2 MeV, four are excited with  $L=3$  angular distributions and five with  $L=1$ . The 4.36 MeV level of ref 1 was not observed. Comparison of the results of the two experiments will be presented.

\*Work supported by the National Science Foundation.

†On leave from Princeton University.

†W. P. Alford, M. Moinester, J. J. Schwartz, BAPS 12,586(1967) and private communication.

Abstract Submitted

For the Boulder, Colorado Meeting of

The American Physical Society

Oct. 30, 31, Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 50

Nuclear  
Instrumentation

Data Acquisition on a Time-Sharing Computer.\* D. L. BAYER, and W. BENENSON, Michigan State Univ.--An on-line, time-shared data taking task providing a fast, flexible method for particle identification has been written for the MSU Sigma-7 computer. To define regions of interest, data is stored in a 16K channel 2D analyzer displayed on 8"X10" storage scope. Fourteen regions of interest can be defined by fitting polynomials to the boundaries of the curves on the scope display. For each region a spectrum is generated by the interrupt servicing routine using table look up.  $\Delta E$ -E particle identification, time-of-flight mass identification, and momentum identification using position sensitive detectors in a spectrometer have been used. To separate neutrons from  $\gamma$ 's a pulse-shape dependent signal is plotted against scintillator output. The third parameter, flight time, generates the neutron and  $\gamma$  spectra. Other three parameters experiments involve redundant particle identification.

\*Work supported by National Science Foundation.



Abstract Submitted

For the Boulder, Colorado Meeting of

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Oct. 30, 31 & Nov. 1, 1969

Physical Review  
Analytic Subject Index  
Number 53

Bulletin Subject Heading in  
which Paper should be placed  
Nuclear Astrophysics

Production of the Light Elements Li, Be, and B  
by Proton Spallation of  $^{12}\text{C}$ .\* CARY N. DAVIDS,† HELMUT  
LAUMER, and SAM M. AUSTIN, Michigan State University.--  
Measurements of the production of the light elements Li,  
Be, and B by the proton bombardment of  $^{12}\text{C}$  have been  
measured for proton energies between 21.7 and 44.0 MeV.  
Time-of-flight methods were used to identify the masses  
of ions recoiling from a thin target into a semiconductor  
detector. The results are related to current models on  
the origin of these light elements, and are consistent  
with a suggestion that the  $^{11}\text{B}/^{10}\text{B}$  isotopic ratio has  
remained unaltered at its formation value.

\*Work supported in part by the National Science Foundation.

†Present address: Center for Nuclear Studies, University  
of Texas, Austin.

Abstract Submitted  
For the Chicago Meeting of  
The American Physical Society  
January 26-29, 1970

Physical Review  
Analytic Subject Index  
Number 54.5

Bulletin Subject Heading  
in which Paper should be  
placed  
Nuclear Reactions:  
One-Nucleon Transfer

$^{20,22}\text{Ne}(p,d)^{19,21}\text{Ne}$  at  $E_p=45$  MeV.\* B. M. PREEDOM, B. H. WILDENTHAL, J. L. SNELGROVE, and E. KASHY, Michigan State Univ.—Angular distributions have been obtained for (p,d) reactions using 45 MeV protons incident on a gas target of natural neon. The data was taken over the angular range from  $10^\circ$  to  $150^\circ$  with an energy resolution of 100 keV(FWHM). Spectroscopic strengths have been obtained for the various neutron transfers using Distorted Wave Calculations corrected for Finite-Range, Non-Locality, and Density-Dependent effects. These strengths will be compared with the predicted values obtained from  $p_{1/2}$ - $d_{5/2}$ - $s_{1/2}$  and  $d_{5/2}$ - $s_{1/2}$ - $d_{3/2}$  shell model calculations for nuclei in the  $A=20$  region.

\*Work supported by the National Science Foundation.

Submitted by

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Abstract Submitted  
For the Washington Meeting of  
The American Physical Society

April 27-30, 1970

Physical Review                      Bulletin Subject Heading  
Analytic Subject Index              in which Paper should be  
Number 55.5                            placed  
Atomic Weight=208  
Charged Particle Reactions

Proton Decay Following (p,n) Reactions on the Pb Isotopes.\* G. M. CRAWLEY, P. S. MILLER and D. L. BAYER, Michigan State University.--The  $^{209}\text{Bi}(p,n\bar{p})$  reaction showed a strong proton decay to the  $[\pi h_{9/2}(\nu f_{5/2})^{-1}]$  multiplet of  $^{208}\text{Bi}$ . This observation was surprising in view of the small proton single particle width extracted for the  $f_{5/2}$  level from resonance experiments on  $^{207}\text{Pb}$  and from the  $^{208}\text{Pb}(p,n\bar{p})$  reaction. It therefore prompted a systematic study of the  $(p,n\bar{p})$  reaction in the lead region. The protons were detected in a  $\Delta E$ -E counter telescope with an intrinsic resolution of 50 keV. Angles and bombarding energies were chosen to minimize the overlap of impurity peaks with the region of interest in the proton spectrum. The results on  $^{208}\text{Pb}$  and  $^{207}\text{Pb}$  indicate the  $f_{5/2}$  proton decay is quite strong for both these isotopes. A comparison with previous experiments will be presented.

\* Work supported in part by the National Science Foundation.

Submitted by

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Abstract Submitted

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April 27-30, 1970

Physical Review  
Analytic Subject Index  
Number 43.4

Imperfections and  
Impurities; Alloys

Measurements of the Isotope Effect on  
the Diffusion Constant of Lithium in Germanium\*.  
E. DOUNCE, C.R. GRUHN, and P.D. FISHER, Mich.  
State Univ.—The isotope effect on the diffusion  
constant of lithium in germanium has been studied  
between 297°K and 773°K. The diffusions were  
made in selected germanium crystals which were  
believed to be free of impurities which might  
reduce the lithium mobility. The diffusion  
constants were measured using the standard p-n  
junction technique with a hot point probe. The  
quantum mechanical description of tunneling  
enhancement of the diffusion.

\* Work supported in part by the National Aeronautics  
and Space Administration and the National Science  
Foundation.

Abstract Submitted  
For the Washington Meeting of  
The American Physical Society

April 27-30, 1970

Physical Review  
Analytic Subject Index  
Number 55.2

The Decay Scheme of Bi<sup>205</sup>.\* K.L. KOSANKE,  
WM. C. MCHARRIS and W.H. KELLY, Michigan State  
University.--We have re-examined the decay of 15.3-d  
Bi<sup>205</sup> with Ge(Li) systems. The Bi<sup>205</sup> sources were  
usually prepared with 36-MeV protons from the MSU  
Sector-Focused Cyclotrons on natural lead foil  
through the Pb<sup>208</sup>(p,4n)Bi<sup>205</sup> reaction; however,  
sources were also prepared using protons on  
separated isotope Pb<sup>206</sup>, and He<sup>3</sup> on natural thallium.  
The Bi<sup>205</sup> was separated from the targets using moderat-  
ely involved chemistry. A total of 99  $\gamma$  rays, in-  
cluding 29 transitions not reported in earlier con-  
version electron studies<sup>1</sup>, were observed. Using  
the results from Ge(Li)-Ge(Li) [4096x4096 channel]  
megachannel coincidence analysis, approximately  
3/4 of these transitions have been placed in a decay  
scheme. This has resulted in making considerable  
changes in the existing level schemes<sup>1</sup> and has  
allowed the placing of most of the remaining transi-  
tions on the basis of energy differences. A study  
of the  $\beta^+$  feeding in this decay, using an 8x8-in.  
NaI(Tl) split annulus in conjunction with a Ge(Li)  
detector has indicated feedings to the following  
states, 0.058 $\pm$ 0.01% to the 703.4- (7/2-), 0.008 $\pm$ 0.004%  
to the 987.5- (9/2-), and <0.002% to the 1043.7-keV  
(7/2-) state.

\* Supported in part by the Atomic Energy Commission  
and the National Science Foundation.

<sup>1</sup>S.H. Vegors, Jr., R.L. Heath, and D.G. Proctor,  
Nucl. Phys. 48, 230 (1963).

Submitted by

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Physical Review  
Analytic Subject Index  
Number 55.2

The Decay of  $Pb^{201}$ .\* R.E. DOEBLER, WM. C. MCHARRIS, and W.H. KELLY, Michigan State University.--Pb was produced using 27-MeV protons from the MSU Sector-Focused Cyclotron to induce the  $Tl^{203}(p,3n)Pb^{201}$  reaction on both natural Tl and separated isotope  $Tl^{203}$ .  $\gamma$ -rays emitted in the decay of the 9.4-h  $Pb^{201}$  to states in  $Tl^{201}$  were studied with Ge(Li) and NaI(Tl) detectors in singles, anti-Compton, anti-coincidence experiments. The placement of most of the 48  $\gamma$  rays in a decay scheme was aided by a two-dimensional "megachannel"  $\gamma$ - $\gamma$  coincidence experiment of 4096x4096 channels using two large-volume Ge(Li) detectors. On the basis of the coincidence experiments, sums and differences, and relative intensities, levels were placed in  $Tl^{201}$  at 0, 331.15, 692.41, 1098.52, 1157.49, 1238.82, 1277.11, 1330.28, 1401.30, 1420.01, 1445.83, 1479.85, 1617.20, and 1672.02 keV, with possible additional levels at 1134.81 and 1639.47 keV. Using the conversion electron data of Aasa, et al.<sup>1</sup> and our  $\gamma$  ray intensities, the conversion coefficients of 22 transitions were calculated. While  $Pb^{201}$  decays primarily by  $\epsilon$  decay, we observed a small amount of  $\beta^+$  feeding to the 1157.49-keV state. Our spin assignments and transition probabilities will be discussed in terms of fairly pure single-particle states.

\* Work supported in part by the U.S. Atomic Energy Commission and the U.S. National Science Foundation.

<sup>1</sup>E. Aasa, T. Sundstrom, O. Bergman, J. Lindskog, and K. Sevier, Ark. Fys. 27, 133 (1964).

Submitted by

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Abstract Submitted

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Physical Review	Bulletin Subject Heading
Analytic Subject Index	in which paper should be
Number 54.5	placed
	Nuclear Structure
	A=21-26

The  $Mg^{24,26}(p,\alpha)Na^{21,23}$  Reactions at 35 MeV,\*  
G.C. MORRISON and R.C. BEARSE, Argonne Natl. Lab.,  
and W. PICKLES and E. KASHY, Michigan State Univ.,--  
Angular distributions of the  $Mg^{24,26}(p,\alpha)$  reactions,  
measured with 35-MeV protons from the MSU cyclotron,  
confirm that the  $(p,\alpha)$  reaction at these energies is  
analogous to the direct  $(d,He^3)$  reaction on an  $(N-2)$   
target; proton-hole states are strongly populated.  
In the  $Mg^{24}(p,\alpha)$  reaction, hole states of negative  
parity in  $Na^{21}$  are observed at 2.81 (one member of  
a doublet) and 3.68 MeV. The  $j$  dependence of the  
 $(p,\alpha)$  angular distribution fixes their spins and  
parities as  $1/2^-$  and  $3/2^-$ , respectively, in agree-  
ment with theoretical expectations but contrary to  
a  $3/2$  assignment for the mirror state of the lower  
at 2.79 MeV in  $Ne^{21}$ . The  $Mg^{26}(p,\alpha)$  reaction to the  
known negative-parity states in  $Na^{23}$  confirms the  $j$   
dependence. The relative strengths of the two re-  
actions to corresponding states are very similar,  
although the  $Mg^{26}$  cross sections are only 1/5 of  
those of  $Mg^{24}$ . Some reduction can be accounted for  
on the Nilsson model of these nuclei.

\*Work performed under the auspices of the U.S.  
Atomic Energy Commission and the National Science  
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Abstract Submitted  
For the Washington Meeting of  
The American Physical Society

April 27-30, 1970

Physical Review  
Analytic Subject Index  
Number 54.2 & 54.5

Nuclear Structure  
A=33-36

Study of States in  $^{33}\text{S}$ ,  $^{34}\text{Cl}$ , and  $^{36}\text{Cl}$   
with the (p,d) Reaction\*. B. H. WILDENTHAL, G. M.  
CRAWLEY, MSU, and W. MCLATCHIE, Queen's Univ.  
Kingston, Ontario. The low-lying even-parity  
levels in  $^{33}\text{S}$ ,  $^{34}\text{Cl}$  and  $^{36}\text{Cl}$  have been studied  
via the (p,d) reaction on carbon backed targets  
isotopically enriched  $^{34}\text{S}$ ,  $\text{Li}^{35}\text{Cl}$  and  $\text{Li}^{35}\text{Cl}$ .  
The proton bombarding energy was 34.8 MeV and the  
deuteron spectra were recorded by a solid state  
counter telescope with 50 keV resolution, FWHM.  
Analyses of the angular distributions with the  
standard local zero-range and with the DFRNL  
versions of the DWBA will be presented. The  
results of level energies and spectroscopic  
factors will be compared to previous data, where  
available, and prediction of shell model calcul-  
ations for the region.

\*Work supported by the National Science Foundation.

Submitted by

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For the Washington Meeting of  
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Physical Review  
Analytic Subject Index  
Number 51.2

Nuclear Structure  
Theory

Negative Parity States in A=21-23 Nuclei\*  
J. B. MCGRORY, Oak Ridge Nat. Lab. and B. H. WILDENTHAL, MSU. We have calculated spectra of nuclei with masses 21, 22, and 23 in a shell model basis space consisting of the  $1p_{1/2}$ ,  $1d_{5/2}$ , and  $2s_{1/2}$  orbits. The model Hamiltonian we employ was determined by adjusting the relevant two-body matrix elements and single particle energies so as to obtain an rms minimum between selected shell model eigenvalues and the experimental energies of corresponding nuclear states. The negative parity energy level data for this process were taken from nuclei in the region  $A=13-20$  and the positive parity data from nuclei of  $A=13$  to 22. Negative parity levels in  $^{21}\text{Ne}$ ,  $^{22}\text{Na}$ , and  $^{23}\text{Na}$  are calculated in good correspondence to levels experimentally observed via  $\ell=1$  pickup.

\*Work supported by the National Science Foundation.

Submitted by

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Abstract Submitted

For the Washington Meeting of  
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April 27-30, 1970

Physical Review	Bulletin Subject Head-
Analytic Subject Index	ing in which paper
Number	should be placed
	Nuclear Instrumentation

High-Resolution 5000 $\mu$  Silicon Surface-Barrier Detectors.\* E. D. KLEMA, Tufts University and G. M. CRAWLEY, Michigan State University.--A 5000 $\mu$  detector fabricated from 90,000 ohm cm. silicon and operated at 1500 volts bias has been tested using the magnetically-analyzed proton beam of the Michigan State University cyclotron. The resolution was set by the slit system of the analyzing magnets to be less than 10 keV in all cases. Targets of thin carbon and solid foils were used. The carbon foil allowed the depth of the detector to be probed by using the kinematics for the elastic and inelastic scattering from carbon to check the linearity of the detector. At a proton bombarding energy of 35 MeV and a lab angle of 100°, the carbon elastic peak just lost all its energy in the detector. The thickness was then calculated in this case to be 4700 $\mu$ . In another run with a gold target to minimize kinematic broadening at a proton energy of 25 MeV, the measured FWHM resolution from the gold peak was 31 keV, the electronic noise as measured with a pulse being 16 keV.

\* Work supported in part by the National Science Foundation.

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Physical Review  
Analytic Subject Index  
Number 53.7

Nuclear Reactions  
and Scattering of  
Deuterons A=14

Elastic and Inelastic Deuterons Scattering on  $^{14}\text{N}$  at 20.15 MeV\*. W.L. PICKLES, and L.L. LEARN, Mich. State Univ.—Absolute differential cross sections of elastically and inelastically scattered deuterons have been measured between  $10^\circ$  and  $170^\circ$ , using a  $^{14}\text{N}$  natural gas target. Absolute error in the elastic cross sections is less than 2% and the energy resolution was 50 to 70 keV. Particle identification was accomplished by "Charged particle time-of-flight", taking advantage of the very narrow time width (250ps) and the excellent phase stability of the MSU Cyclotron. A time resolution of 600ps (FWHM) was achieved resulting in complete separation of mass 1, 2, 3, and 4 particles. All T=0 states in  $^{14}\text{N}$  up to about 15.5 MeV were observed and in most cases well resolved. No T=1 or greater states were observed and upper limits for these cross sections have been placed. Experimental details, spectroscopy of  $^{14}\text{N}$ , and the results of the elastic scattering analysis will be discussed.

\*Work supported by the National Science Foundation.

Abstract Submitted

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Physical Review  
Analytic Subject Index  
Number 55.5

Bulletin Subject Heading  
in which Paper should be  
placed  
Nuclear Reactions:  
One-Nucleon Transfer

Hole States in N=81 Nuclei\*. R. K. JOLLY,  
E. KASHY, and F. TRENTELMAN, Michigan State  
University. Hole states in the  $50 < N < 82$  shell  
have been studied in (p,d) reaction on  $^{138}\text{Ba}$ ,  
 $^{140}\text{Ce}$ ,  $^{142}\text{Nd}$  and  $^{144}\text{Sm}$  nuclei all of which have  
N=82. Approximately  $0.5 \text{ mg/cm}^2$  targets of these  
isotopes were bombarded with 35-36 MeV protons  
from the MSU Cyclotron. Energy spectra of the  
residual nuclei up to several MeV of excitation  
energy were measured from  $12.5^\circ$  to  $80^\circ$ . The  
experimental results together with DWBA calcu-  
lations including the effects of finite range,  
nonlocality and density dependence<sup>1</sup> will be  
presented and discussed.

\*Work supported by the National Science Foundation.

<sup>1</sup>B. M. Freedom, J. L. Snelgrove and E. Kashy (sub-  
mitted to Physical Review)

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