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SUMMARY OF THE RESEARCH PROGRESS MEETING OF JUNE 21, 1951

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September 11, 1951

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Berkeley, California

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SUMMARY OF THE RESEARCH PROGRESS MEETING OF JUNE 21, 1951

Bonnie E. Cushman

Radiation Laboratory, Department of Physics
University of California, Berkeley, California

September 11, 1951

I. Micromagnetic Susceptibility Measurements. W. Crane.

The magnetic susceptibilities of the actinides have been found to be lower than the corresponding lanthanides, possibly indicating that the molecular field constant in the Curie-Weiss law is larger in the heavier series. Because of the electron configuration for Cm^{+3}, its Heisenberg exchange forces are independent of temperature, and their values will be approximately the same as those for the other actinides.

The gram susceptibility and temperature dependence of CmF_3 were measured with a quartz torsion microgram balance in a vacuum of 10^{-5} mm to avoid turbulence (Fig. 1). $FeSO_4(NH_4)_2SO_4 \cdot 6H_2O$ was used as the primary standard and GdF_3 as the secondary. A molar susceptibility of $24{,}000 \times 10^{-6} \pm 500$ c.g.s. units was obtained for CmF_3, corresponding closely to that for GdF_3, (Fig. 2). The molecular field constant could not be measured directly since the temperature of the sample increased in the vacuum due to its radioactivity. It was determined to be at most 30° by measuring the susceptibility of a mixture of 10% CmF_3 and 90% LaF_3 (the Heisenberg forces disappear when a paramagnetic substance is diluted with a diamagnetic material).

Details of this work can be found in UCRL-1220.

II. Doubly Charged Nucleons. L. W. Alvarez and J. K. Bowker

Strong coupling meson theories predict the existence of proton isobars of charge +2 and -1. A search for the doubly charged particle of unit mass has been made. A carbon target was bombarded by 350 Mev protons and plates were placed under the circulating beam in such a way that +2 particles would strike them after a magnetic deflection of 180°. About twenty tracks were found with approximately the correct range and grain density to indicate the existence of "He^1". These tracks could arise from He^4 particles from neighboring parts of the shielding. To check on this possibility, the grain density and scattering of the suspected He^1 tracks were measured. (Either of these measurements could give an independent value of the mass of the particle responsible for the track.) The first result of these measurements was that the tracks were probably due to He^1, so one could then use the magnetic deflection and range data to give an accurate mass value. The grain count measurements were then repeated by several independent observers, and it was concluded that the tracks were due to "stray alpha particles." The scattering measurements indicate a lower mass, but mass measurements by this technique have large random errors. It is concluded that there are no indications from this experiment that doubly charged nucleons exist.

Information Division
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III. Angular Distribution of d-n Reactions. W. Heckrotte

The angular distribution of neutrons produced by the bombardment of various targets with 20 Mev deuterons has been analyzed in terms of spins and parities. Briefly the theory involves this: The deuteron must be held together long enough so that the binding energy, given up when the proton sticks to a nucleus, can be transferred partly or completely to the neutron. If the angular distribution of these neutrons is regular enough that probably only one final state determines it, parities and spins can be assigned to that state (or the initial state - knowing the value for one or the other).

The experimental facts and their correlation with Butler's theory are given in detail by L. Schecter in UCRL-1204. Later work is indicated in UCRL-1273 Abstract and it was stated today that further investigations will be made soon on Mn, Co and Au. Recent results are shown in Figures 3 and 4.

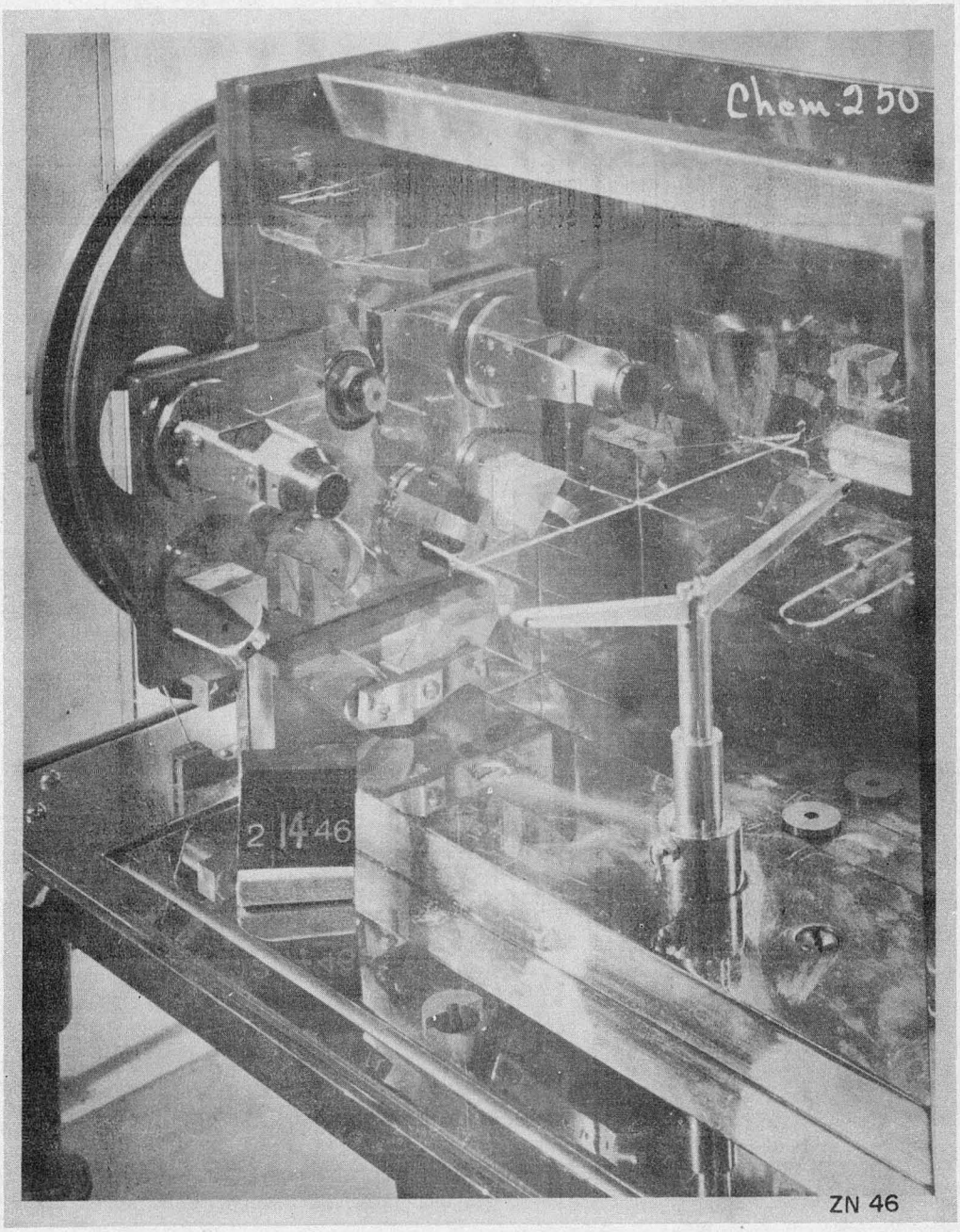

Fig. 1

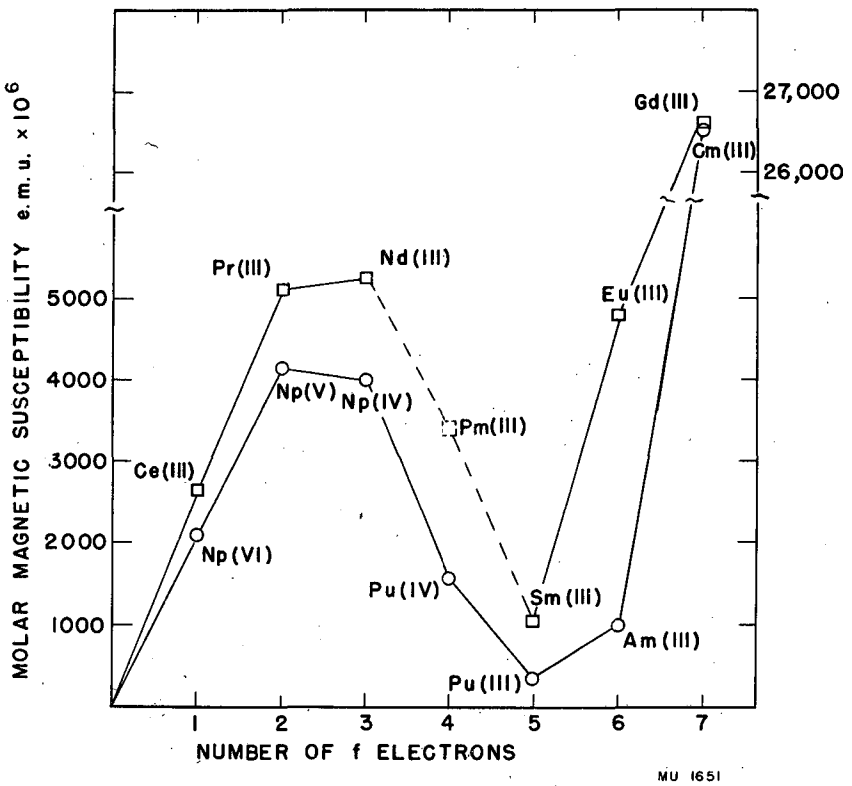
MOLAR MAGNETIC SUSCEPTIBILITY e.m.u. x 10^6
NUMBER OF f ELECTRONS
1000
2000
3000
4000
5000
27,000
26,000
1
2
3
4
5
6
7
Ce(III)
Pr(III)
Nd(III)
Pm(III)
Sm(III)
Eu(III)
Gd(III)
Cm(III)
Np(VI)
Np(V)
Np(IV)
Pu(IV)
Pu(III)
Am(III)
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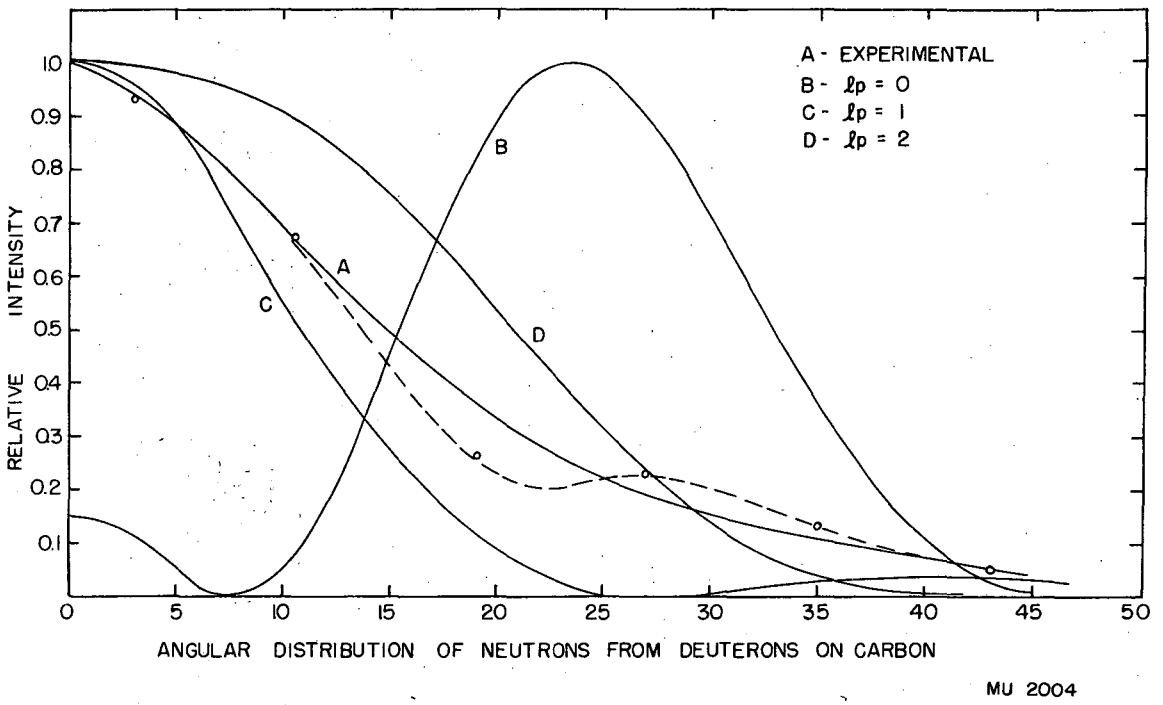
Fig. 2


A - EXPERIMENTAL
B - ℓp = 0
C - ℓp = 1
D - ℓp = 2
A
B
C
D
RELATIVE INTENSITY
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
5
10
15
20
25
30
35
40
45
50
ANGULAR DISTRIBUTION OF NEUTRONS FROM DEUTERONS ON CARBON
MU 2004

178201

Fig. 3

REACTION	GROUND STATE OF INITIAL NUCLEUS		ℓp	STATE OF FINAL NUCLEUS	
$Be^9(d,n)B^{10}$	$\frac{3}{2}, \frac{5}{2}, \frac{7}{2}, \frac{9}{2}$	-	1	3	+
$C^{12}(d,n)N^{13}$	0	+	1	$\frac{1}{2}, \frac{3}{2}$	−
$Al^{27}(d,n)Si^{28}$	$\frac{5}{2}$	+	0	2,3	+
$Cu^{63}(d,n)Zn^{64}$	$\frac{3}{2}, \frac{5}{2}$	+	2	0	+

RESULTS OF ANALYSIS - ℓp IS THE ANGULAR MOMENTUM TRANSFERRED TO THE TARGET NUCLEUS

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Fig. 4