JOURANL OF THE PHYSICAL SOCIETY OF JAPAN VOL. 34, SUPPLEMENT, 1973
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON NUCLEAR MOMENTS AND NUCLEAR STRUCTURE, 1972

III.i. Magnetic Moments of the 12^- States in ^{196,198,200}Au*

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(Presented by D. A. Shirley)

Low-temperature nuclear orientation experiments have been used to obtain the magnetic moments of three spin 12 gold isomers. The ^{200m}Au moment is consistent with anomalous orbital magnetism.

The magnetic moment of the $h_{9/2}$ proton outside the ^{208}Pb core is quite well known from ^{209}Bi and ^{210}Po. The large deviation from the single particle value could only partially be explained by spin polarization while the remainder was attributed to an anomalous orbital magnetism Δg_l.[1] In this context, it seemed desirable to determine the magnetic moment of the spin orbit partner $h_{11/2}$ proton (hole).

The nuclei closest to ^{208}Pb with $h_{11/2}$ components are the Au isotopes; in the even mass Au isotopes the coupling of an $h_{11/2}$ proton hole to an $i_{13/2}$ neutron hole leads to low-lying isomeric states with $I=12$.

Using thermal equilibrium nuclear orientation techniques, we have measured the magnetic moment of the 12^- states in ^{196}Au and ^{200}Au. With NMR on oriented ^{200m}Au(Ni) a more precise value of the g factor could be obtained. In ^{198}Au we have found a new isomer which is very likely the corresponding 12^- state to the neighboring ^{196}Au and ^{200}Au.

In Table I the moments are given for the three isotopes. They were derived from the measured interaction using the hyperfine field values as determined with the 2^- ground state of ^{198}Au. A small correction of 2.5% for hyperfine anomaly is included.[2] Our data also indicate the spin of ^{200m}Au as $I=12$.

From the measured moment of ^{200m}Au where the experimental error can be neglected in comparison to the estimated error for the applied correction we can deduce the proton contribution. Taking the neutron part as $\mu(i_{13/2})=-1.0$ n.m. (from Dr. Nagamiya's Table IV, this conference) we obtain $\mu(h_{11/2})=7.1$ n.m., *i.e.* $g(h_{11/2})=1.29$, which is in only fair agreement with $\mu(h_{11/2})_{core}=6.7$ n.m. calculated with the spin polarization procedure of Arima and Horie. Our larger value may arise in part from anomalous magnetism of the proton.

Table I. Magnetic moments of the 12^- states in even mass Au isotopes.

A	$T_{1/2}$ [h]	Method	μ [n.m.]	μ_{corr} [n.m.]
196	9.7	NO	5.24(20)	5.35(20)
198	49	NO	5.40(34)	5.55(34)
200	18.7	NMR/ON	5.90(4)	6.10(10)

* Work performed under the auspices of the U. S. Atomic Energy Commission.
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References

1) S. Nagamiya and T. Yamazaki: Phys. Rev. **C4** (1971) 1961.
2) F. Bacon, G. Kaindl, H.-E. Mahnke and D. A. Shirley: Phys. Letters **37B** (1971) 181.

Discussion

S. S. HANNA (Stanford Univ.): Since you showed a piece of experimental apparatus, I would like to take the liberty of asking a question about it. Do you feel you can handle as large a heat load with the adiabatic demagnetization method as you can with the ^{3}He dilution refrigerator?

SHIRLEY: Well, when one compares adiabatic demagnetization with dilution refrigerators, one has to make sure that the variables are really comparable. If one is talking about keeping the sample cool to 100 millidegrees or 50 or even 30 millidegrees, I think the dilution refrigerator is a far more convenient way to do it. However, there are very few cases in which you can orient nuclei, or at least saturate the orientation, at 30 millidegrees. I think the adiabatic demagnetization, which can take you down to 3 millidegrees at present, is then preferable. At these low temperatures, the dilution refrigerator has essentially zero capability. It is hard to get the dilution refrigerator down to anywhere near this temperature region. So there is this region around 10 millidegrees, or perhaps even somewhat higher, where the adiabatic demagnetization method is definitely superior in that you can absorb more heat.