The Hyperfine Structure and Nuclear Moment of Gold

The spectra of Au I and Au II were excited in a horizontal water-cooled hollow cathode tube and in a vertical liquid air-cooled tube. The tubes were operated with an applied voltage of 1000 and from 30 to 500 m.a. current. Reversal of the resonance lines of Au I took place down to 75 m.a. of current. The spectra were first examined in the higher orders of the 35 foot 30,000 lines per inch concave grating of the Institute and then examined with Fabry-Perot etalons of 5–25 mm spacing. For the region above 4500A evaporated silver films were employed, below 3000A aluminum-silicon, and aluminum for the intermediate region. Above 3500A the etalon was employed in the parallel beam of a Zeiss three-prism spectrograph and below 3500 the rings were projected on the slit of a Hilger E1 spectrograph with a long focal length achromat.

The splitting of the resonance lines is in good agreement with previous results of Ritschl.[1] The slight difference in splitting in the two lines 0.003 cm^{-1} can be attributed partially to the influence of the p level. A detailed intensity study of the two components in each of the lines using high contrast plates and stepped exposures as well as measurements with calibrated screens[2] permits a determination of $I=3/2$ with greater certainty.

Many of the lines such as 4607, 4488, 4439, 3029, 2883, and 2388, show four components. The levels involved have been investigated in other lines and in most cases can be relegated to a hyperfine structure term system if an I value of 3/2 is assumed which confirms Ritschl's previous assumption. The interval rule is better satisfied in a number of levels for an I value of 5/2 yet one would not expect it to be valid in view of the character of the coupling involved. Those levels of copper which show large isotope shifts have been investigated in gold. The relatively slight abundance of the weaker isotope and the apparent fine splitting involved does not permit any conclusion to be drawn in regard to its nuclear moment.

A detailed report of the above will be published in the near future.

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[1] Ritschl, Naturwiss. p. 690, 1931.
[2] Harrison, J.O.S.A. **19**, 267 (1929).

Stability of Beryllium

The existence of the alpha-radioactivity of beryllium reported by Langer and Raitt[1] having been made questionable by the work of Evans and Henderson[2] with the linear amplifier, a search for particle radiation of any kind, excepting neutrons possibly, with a sensitivity at least equal to those of the above-mentioned measurements for alpha-particles appeared to be of some interest.

This has been done by means of Geiger-Müller tube counters modified by using 40×40 mesh copper screen for the wall. The counter used had a diameter of 3.5 cm, a length of 17.5 cm, and a zero count of about 30 per minute when shielded from visible light, γ-rays, and cosmic rays by tar paper and an iron shield 1 ft. thick in nearly all directions. Air was used in the chamber at about 2 cm pressure and the operating voltages ranged between 1000 and 1300 volts. The amplifying mechanism was essentially that previously described.[3]

Samples were deposited uniformly over an area of 437 cm^2 by moistening soluble salts with alcohol and drying on the inner surface of a glass cylinder just large enough to slide over the screen counter. The effect per mole of KCl was repeatedly found to agree with 2780±200 counts per half minute. Since potassium is known to emit 27,500 per half minute this shows that about 10 percent of the emitted particles are counted in the case of the potassium β-rays.

Beryllium samples from three different commercial sources were used. All gave activities within 30 percent of a mean before purification. Because this mean value agreed with the Langer and Raitt value it was at first assumed that the activity was really due to Be. A screening test on one sample however showed that 16 percent passed through 0.08 mm of aluminum (13 cm air equivalent stopping power for α-particles) eliminating the possibility of the radiation being solely alpha in nature. Subsequent purification of one of the samples ($Be(NO_3)_2$ of Kahlbaum) gave a sample 0.034 mole of which deposited on the 437 cm^2 of glass surface as a mixture of BeO, $BeCl_2$, and $Be(NO_3)_2$ gave the results in Table I.

TABLE I.

Run	*Zero Count* Count	Time (½ min.)	Rate	*Zero Count Be Effect* Count	Time	Rate
No. 1	1696	101	16.8±0.3	2583	158	16.4±0.2
No. 2	2215	168	13.2±0.2	1468	110	13.3±0.2
	Effect = 0±0.24					
	Effect/mole = 0±7					

The probable errors given were found by the use of the Bateman formula ($r=0.67(\text{average rate})^{\frac{1}{2}}$) which is known to hold for this work as a result of somewhat extensive investigation during the last two years.

If one takes three times the probable error as an upper limit for the possible activity and assumes the $7.8\cdot10^{-5}$

[1] Langer and Raitt, Phys. Rev. **43**, 585 (1933).
[2] R. D. Evans and M. C. Henderson, Phys. Rev. **44**, 59 (1933).
[3] Libby, Phys. Rev. **42**, 440 (1932).