The *F* Terms of Ce IV

Following the publication by the author of a partial analysis[1] of the spectrum of Ce IV considerable interest appeared concerning the position of the *F* terms. These terms have now been located and this opportunity is taken to give a brief note concerning them. A rather complete analysis of the spectrum is now nearing completion and details will be published elsewhere.

The $5F$ terms are quite regular as compared with neighboring ions of similar electronic structure and are given by the following lines:

$5D_{1\frac{1}{2}}-5F_{2\frac{1}{2}}$ 741.79 (40) 134,809
$5D_{2\frac{1}{2}}-5F_{3\frac{1}{2}}$ 754.60 (30) 132,520
$5D_{2\frac{1}{2}}-5F_{2\frac{1}{2}}$ 755.75 (12) 132,319.

The question whether the $4F$ or the $5D$ terms are the deepest in the spectrum is a very interesting one and seems now to be definitely settled in favor of the former possibility. The lines involved are:

$4F_{2\frac{1}{2}}-5D_{1\frac{1}{2}}$ 2009.94 (100) 49,737
$4F_{3\frac{1}{2}}-5D_{2\frac{1}{2}}$ 2000.42 (100) 49,973
$4F_{2\frac{1}{2}}-5D_{2\frac{1}{2}}$ 1914.75 (35) 52,226.

The following term values are based upon three *S* terms using a Ritz formula.

$4F_{2\frac{1}{2}}$ 296,197 $5F_{2\frac{1}{2}}$ 111,652
$4F_{3\frac{1}{2}}$ 293,944 $5F_{3\frac{1}{2}}$ 111,451.

The reality of these terms is confirmed by the $5G$ combinations and also by the fact that the $4F$ interval corresponds sufficiently well with the proper intervals in the low terms of Ce III.

R. J. Lang

University of Alberta,
Edmonton, Alberta, Canada,
March 10, 1936.

[1] R. J. Lang, Can. J. Research **A13**, 1 (1935).

Magnetic Moment of the Li^7 Nucleus

The value of the magnetic moment of the Li^7 nucleus has been determined in two different ways. Breit and Doermann[1] calculated it to be 3.28 nuclear magnetons, on the basis of hyperfine structure measurements of the $^3P_0-{}^3S_1$ group of Li^+. Fox and Rabi,[2] by the molecular beam method, found the hfs separation of the ground state ($^2S_{\frac{1}{2}}$) of the normal Li atom to be $\Delta(s)=0.0267\pm0.0003$ cm^{-1}. The resulting value of the nuclear magnetic moment, estimated from the Goudsmit-Fermi-Segrè formulae, was found to be 3.20 nuclear magnetons. However, even apart from other objections[3] to the GFS formulae, it is not to be expected that a statistical theory will yield correct results for an atom as light as lithium. Therefore, a more accurate calculation is desirable.

Recently, Fock and Petrashen[4] have published values of wave functions (self-consistent with exchange) for lithium. For the 2*s* electron, the value of $\chi=(f_{20}/r)$ at the origin is 1.44. The value of the nuclear magnetic moment, in terms of nuclear magnetons, is[3] $g=949\ \Delta(s)[I/(2I+1)]\times[1/\chi^2(0)=4.58$. This is in disagreement with the above value of 3.28 as found by Breit and Doermann.

Fock and Petrashen have also calculated the transition probabilities for some members of the principal series of lithium. The agreement with observation[5] is mostly qualitative, and not quantitative. This work indicates, then, that the Fock functions are inadequate for transition probability calculations. Our work shows that the same is true for nuclear moment calculations, if the theory be supposed to be correct.

It may be possible, with more accurate wave functions, to resolve the above discrepancy between 4.58 and 3.28. This is being investigated.

James H. Bartlett, Jr.
J. J. Gibbons, Jr.

Department of Physics,
University of Illinois,
March 6, 1936.

[1] Breit and Doermann, Phys. Rev. **36**, 1262 (1930).
[2] Fox and Rabi, Phys. Rev. **48**, 746 (1935).
[3] Gibbons and Bartlett, Phys. Rev. **47**, 692 (1935).
[4] Fock and Petrashen, Physik. Zeits. Sowjetunion **8**, 547 (1935).
[5] A. Filippov, Zeits. f. Physik **69**, 526 (1931). The disagreement between these observations and Fock's theory seems to be quite outside the experimental error.

A New Form of Crystalline Quartz at −183.5°C

When *X*, *Y* and specially oriented *Y* cuts,[1] encased in an air-tight brass crystal holder (Fig. 1), were subjected to low temperatures, they ceased abruptly to oscillate piezoelectrically near the boiling point of liquid air. In one set of experiments these cuts of quartz were driven by a Hartley oscillator. Resonance responses of the plates were noted by listening for the corresponding characteristic disturbances produced in the horn of an amplifier which was connected across a portion of the Hartley plate circuit. This method is perhaps the most sensitive test[2] for the piezoelectric property. In another set of experiments specially oriented *Y* cuts were placed in the usual nonregenerative crystal oscillator circuits. These circuits ceased abruptly to oscillate near the boiling point of liquid air. Piezoelectric activity increased steadily from room temperature to approximately −175°C. By immersing the crystal holder in liquid oxygen boiled under reduced pressure, the temperature at which alpha quartz is transformed to the nonpiezoelectric form, called δ quartz, was found to be −183.5°C. The temperature of the $\delta\rightarrow\alpha$ transition occurs above the boiling point of liquid oxygen at atmospheric pressure. The range permitted by our

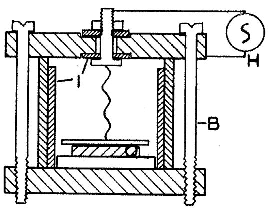

FIG. 1. Crystal holder. *B*, one of six brass bolts; *H*, Hartley oscillator; *I*, insulators; *Q*, quartz plate.