Alpha-Particles from Lithium Ions Striking Hydrogen Compounds

We have bombarded hydrogen compounds with 240,000 volt Li ions and have observed a small but apparently significant number of α-particles resulting from the disintegration of Li (probably Li^7).

The source of high potential was a Holtz electrostatic machine with 14 motor-driven 32-inch plates. The Li ions were emitted from a platinum strip coated with spodumene and heated by means of batteries contained in an insulated metal box at the high potential end of a three stage cascade type accelerator in a horizontal 4-inch glass tube. The tube was evacuated by an oil diffusion pump (speed 30 liters per second) backed by a Cenco hypervac pump. Operating pressures were of the order of 10^{-5} mm Hg.

Three targets (copper coated with NH_4Cl, copper coated with $Al(OH)_3$ and bare copper) were mounted on a ground joint so that any one could be brought into the beam of Li ions. The targets were inclined to the beam at an angle of 45° and directly above the target was a mica window of 2.6 cm stopping power. Immediately above the window was mounted a linear point counter which was connected by means of a linear amplifier to an impulse counter. The point counter was operated at such a potential below the breakdown potential that only α-particles were counted.

With the electrostatic machine operating at full speed (approximately at 240,000 volts), the temperature of the platinum strip was adjusted so that the focal spot of the Li ions (as observed by the fluorescence of a quartz plate) was about 1 cm in diameter. Under these conditions, the current carried by Li ions striking the target was approximately 5 microamperes and counts were recorded as follows:

(1) With the NH_4Cl target, a total of 20 counts in 4 periods of 10 minutes each, i.e., 0.5 per minute.

(2) With the $Al(OH)_3$ target, a total of 13 counts in 3 periods of 10 minutes each, i.e., 0.4 per minute.

(3) Between each 10-minute period was a period of 10 minutes during which counts were taken with an absorber of approximately 15 cm stopping power between the point counter and the mica window. A total of 1 count was observed in 4 such periods, indicating that only α-particles were registered in (1) and (2).

(4) With the bare copper target, a total of 2 counts was recorded in 2 periods of 10 minutes each. This was attributed to radioactive contamination around or below the mica window, for with the high potential cut off, 8 counts were recorded in 100 minutes, i.e., 0.1 per minute, approximately, in both cases.

The net count is therefore 0.4 per minute with the NH_4Cl target and 0.3 per minute with the $Al(OH)_3$ target. These coatings were thick in comparison with Li^+ ranges. The effective solid angle was approximately 1/150 so that the total numbers of α-particles produced per minute per microampere when 240,000 volt Li ions strike NH_4Cl and $Al(OH)_3$ are approximately 12 and 9, respectively.

The small yield of α-particles indicates that 240,000 electron-volts must be only slightly above the threshold energy required for disintegration under these conditions. The threshold energy required to disintegrate Li under bombardment by protons is about 32,000 e.v.[1] If for disintegration the relative velocity of the two particles is critical, then we might expect Li to be disintegrated on bombarding hydrogen, if the Li ions had a minimum energy of about 225,000 e.v.

Due to the small yield of α-particles, no measurements have yet been made on their range which must, however, have been between 4 cm and 19 cm.

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[1] M. L. E. Oliphant and Lord Rutherford, Proc. Roy. Soc. **A141**, 267 (1933).

Vibration-Rotation Bands of Hydrogen Fluoride

With a twenty-one foot, 15,000 line, concave grating spectrograph, fifteen and eleven lines, respectively, of the $(3\leftarrow 0)$ and $(4\leftarrow 0)$ vibration-rotation bands of HF gas have been photographed at 8790A and 6744A.

The following rotational constants in wave numbers in vacuum have been calculated and are expressed in the notation suggested by Mulliken[1] in his Eqs. (2c) through (4c). $B_e=20.917$ cm^{-1}; $\alpha_e=0.749$ cm^{-1}; $D_e=-0.00215$ cm^{-1}; $\beta_e=0.000285$ cm^{-1}. The values for the first two of these constants can be compared and are in good agreement with calculations from Czerny's[2] equation for the measurements by Imes[3] on the $(1\leftarrow 0)$ band.

The vibrational constants determined from the $(3\leftarrow 0)$ and $(4\leftarrow 0)$ bands are $\omega_e=4123.12$ cm^{-1} and $\omega_e x_e=83.04$ cm^{-1}, but with these values, the difference between the observed and the calculated positions of the $(1\leftarrow 0)$ band center is 5.5 cm^{-1}. To calculate both the fundamental and the two overtone band centers it is apparently necessary to use an $\omega_e y_e$ term, in which case $\omega_e=4141.305$ cm^{-1}, $\omega_e x_e=90.866$ cm^{-1}, and $\omega_e y_e=0.921$ cm^{-1}. Either of these values of $\omega_e x_e$ differs markedly from that which previously has been calculated with the use of observations made on the unresolved $(2\leftarrow 0)$ band by Schaefer and Thomas.[4]

Longer absorption cells are no being used in an attempt to measure still higher harmonics and the work will be presented later in greater detail.

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[2] M. Czerny, Zeits. f. Physik **45**, 476 (1927).
[3] E. S. Imes, Astrophys. J. **50**, 251 (1919).
[4] C. Schaefer and M. Thomas, Zeits. f. Physik **12**, 330 (1923).