portant factor in the calculations. There is agreement between the present mean life results and the recent beam-foil measurements of Heroux [3] and Bromander [5] and with the electron impact phase-shift method results of Lawrence [4].

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INJECTION AND MOBILITY OF POTASSIUM IONS IN LIQUID HELIUM *

G. G. IHAS and T. M. SANDERS Jr.
H.M.Randall Physics Labs, University of Michigan, Ann Arbor, Michigan, USA

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Potassium ions from a hot tungsten wire are injected into He II; their mobility is found to be two to three percent lower than that of 'normal' positive ions.

Charged carriers produced in liquid helium along the track of an ionizing particle have been studied in a variety of experiments [1]. According to the model of Atkins [2], the positive carrier consists of a helium ion surrounded by a 'snowball' of solid helium of radius about 6 Å and mass about $40 M_{He}$ (160 amu). The solidification is caused by the electrostrictive pressure due to the Coulomb field of the central ion. Further, theory predicts that the mobility (μ) of such a carrier will be independent of its mass provided its recoil in a collision with an elementary excitation is negligible. We have tested this prediction by measuring the difference between the mobility of 'normal' positive carriers and positive carriers in which the central helium ion of the 'normal' complex is replaced by an ion of potassium. Since the Coulomb field is then the same as in the normal case and both masses are large compared to the roton mass, the Atkins model leads to equal mobilities.

Tungsten filament wire (General Electric type 218) doped with approximately 100 ppm potassium becomes a source of potassium ions when heated. Vacuum emission mass spectrometry of these wires showed that after an initial cleanup period only electrons and K^+ ions were emitted. Preliminary operation of wires of 7 μm diameter without any other sources present under He II [3, 4], established that positive ions could be injected into the liquid, even when the source voltage was well below threshold for ionization of helium, with a mobilitiy close to that of the 'normal' ion [1]. There seems to be no mechanism for the production of any ion other than potassium. Therefore, an apparatus to directly measure the difference of the mobilities of the two ions was constructed.

Two filament wires S_2 and a ^{210}Po radioactive source S_1 were mounted at the source (top) end of a time-of-flight spectrometer, in a cell in which the helium level could be maintained for optimum wire operation. The mobility apparatus (see insert in fig. 1) consisted of sources (S_1 and S_2), two-grid gate (G_1 and G_2), 2.5 cm drift region with field homogenizers (H_1, H_2 and H_3), Frisch grid (G_F), and collector (C) with guard ring (R); current pulses were detected using a fast FET electrometer, time-averaging computer, and *XY* plotter. Carriers of either polarity, coming from either radioac-

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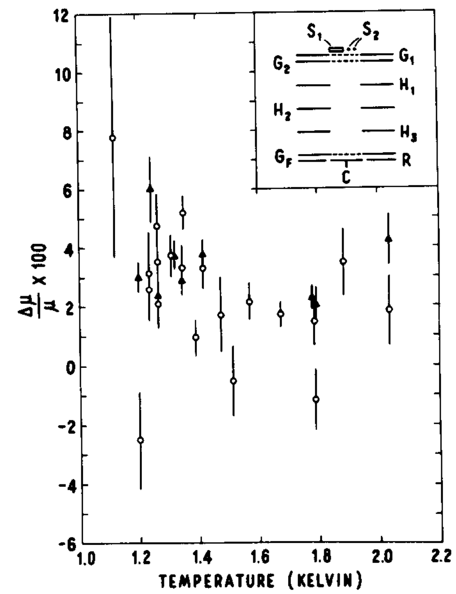

Fig. 1. Fractional difference in mobility between potassium ions and 'normal8 ions. The circles and triangles denote data taken using the first and second methods (see text), respectively. The insert shows the time-of-flight cell.

tive or hot-wire source, could be studied individually by appropriately setting the various electrode potentials. When comparisons of times-of-flight from the two different sources were being made, care was taken that the power dissipated in the hot-wire remained constant, to insure that convective effects were identical during both measurements. Also, all electric fields were kept the same except those between S_1, S_2, and G_1 (one source being reverse biased while the other was forward biased). Data were taken in two different ways: in the first, one signal at a time was summed in the computer, a time-of-flight was obtained for each species, and the results were compared later. In the second (differential) method, alternate signals from the two sources were electronically subtracted in the memory, directly yielding the difference of the two mobilities.

The results for positive ions from the two types of sources are shown in fig. 1. When a similar comparison is made of the times-of-flight of negative carriers *no difference* is detected, even though the negative carrier is more sensitive to effects such as convection than positives. Within the precision of our data, the mobility of the potassium ions appears to be lower by 2 or 3% throughout the temperature range studied (1.1-2.1^{o}K). The error bars represent the total error for each fractional difference measurement.

This result, that a change in the mass of the core ion from 4 (or 8) amu to about 40 amu produces only a small change in mobility, is generally consistent with the electrostrictive model of the ion and present theory of mobility [5]. A detailed comparison must, however, await a theory of residual recoil corrections in the roton-scattering region.

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