sured a marked enhancement of the plasma velocity associated with the passage of the stream. Several of the larger events noted here have also been observed by Van Allen, Frank, and Venkatesan on Injun[10] and by Masely, Adams, and Goedeke, using polar riometers.[11] However, the Explorer-XIV observations provided the first opportunity to undertake a systematic study with sufficient sensitivity to identify the particle species, to obtain energy spectra, and to make evident the long-term recurrent nature of these events.

The identification of the solar region responsible for *M*-type disturbance has long been controversial. The two Explorer-XII recurrence events in 1961 showed conclusively that the particle streams and initial *M*-type magnetic storms began within one day of central meridian passage of the parent region. This indicates a far greater lateral spread of the plasma stream than had been previously assumed. The 1963 events display a similar behavior. Our tentative identification of the appropriate solar region would be a continuation of that proposed by Snyder. Again, the anomalous short-transit types can be accounted for in terms of the great lateral spread.

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THREE DISCRETE Q VALUES IN Ar^+-Ar COLLISIONS*

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In Ar^+-Ar collisions having a distance of closest approach of about 0.23 Å, three discrete values exist for the inelastic energy loss Q. First seen by Morgan and Everhart,[1] these were investigated in more detail by Afrosimov, Gordeev, Panov, and Fedorenko,[2] who interpreted these as three separate collective-excitation levels during the collision. The present paper describes coincidence measurements of charge-state correlation which suggest that the three levels arise instead from two excitation levels in each argon atom.

At 25-keV incident energy the three peaks in the distribution in Q are found for the reaction

$$Ar^+ + Ar \rightarrow Ar^{m+} + Ar^{n+} + (m+n-1)e \qquad (1)$$

at scattering angles between about 13° and 19°. The phenomena show most clearly at 16° where the present data were taken.[3] Here the average values are $Q^{I} = 90$ eV, $Q^{II} = 380$ eV, and $Q^{III} = 610$ eV, all ±20 eV. For each peak and each (m,n) value, there is a different angle between the scattered and recoil particle. Having fixed the scattering angle at (say) 16°, an appropriate setting of the recoil angle allows one to study by coincidence techniques the simultaneous correlations between m and n within each class-j collision ($j = \mathrm{I, II, III}$).

Thus $P_{mn}{}^{j}$ is measured, which is the relative probability of the m,n event within class j. In all cases $P_{mn}{}^{j}$ is found to equal $P_{nm}{}^{j}$ within data scatter. The relative probability P_n of the recoil particle being n times ionized is also measured, since $P_n{}^{j} = \sum_m P_{mn}{}^{j}$, and the same is true with m and n interchanged.

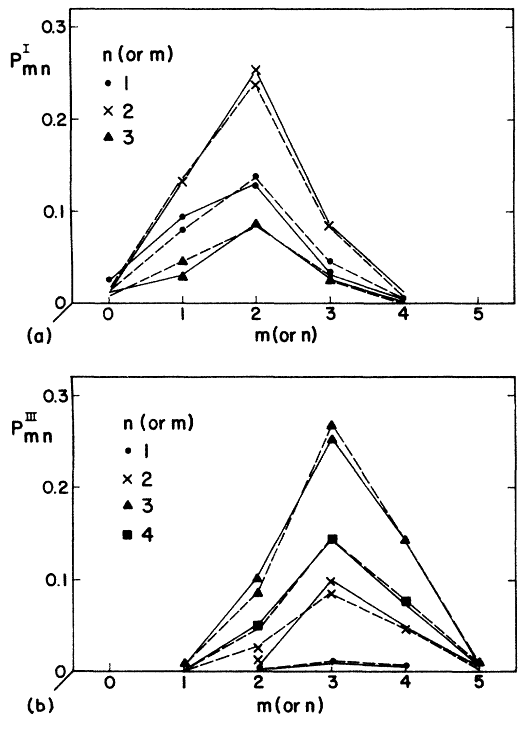

FIG. 1. Probabilities P_{mn} of seeing charge state m simultaneously with n in Ar$^+$-Ar collisions are plotted versus m. The data (solid lines) are compared with the predictions (dashed lines) of Eq. (2), which assumes no correlations between m and n. Here (a) is for $Q^{\rm I}$ data and (b) is for $Q^{\rm III}$ data.

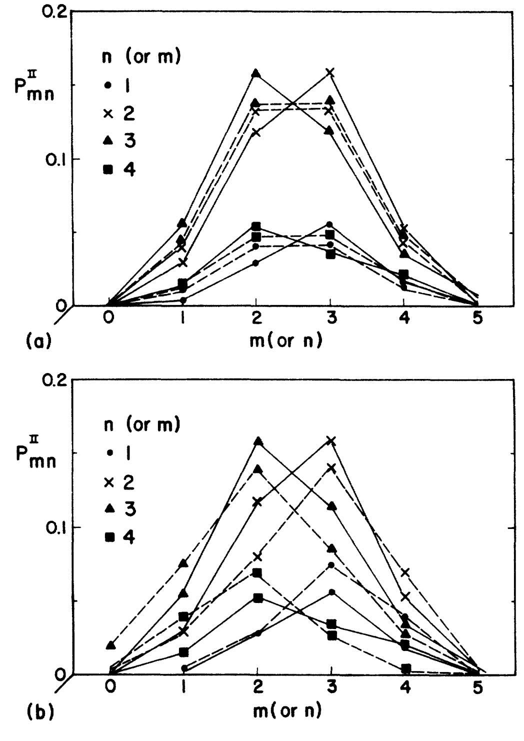

FIG. 2. Probabilities P_{mn} of seeing charge state m simultaneously with n in Ar$^+$-Ar collisions are plotted versus m for $Q^{\rm II}$ data (solid lines, which are the same in both parts). The dashed lines in (a) are the predictions of Eq. (2), which assumes no correlation between m and n, and the dashed lines in (b) are the predictions of Eq. (3), which assumes a particular form of correlation.

It was recently established[4] that there is (outside the triple-Q regions) no correlation between m and n, i.e., the ionizing transitions occur after the particles have been separated. Each class j is here examined for correlation. If there is no correlation then the measured $P_{mn}^{\;j}$ can be predicted by combining $P_n^{\;j}$ and $P_m^{\;j}$ values according to the law of probabilities for independent events, which requires

$$P_{mn}^{\;j}=P_m^{\;j}P_n^{\;j}. \tag{2}$$

Figures 1(a) and 1(b) compare the $P_{mn}^{\;j}$ data with the predictions of Eq. (2), and these show excellent agreement for $j=\rm I$ and III, so that m and n are independent and uncorrelated for the $Q^{\rm I}$ and $Q^{\rm III}$ data.

However, Fig. 2(a) shows that the $j=\rm II$ data systematically deviate from Eq. (2) predictions. When $n=1$ or 2, then m is most likely 3, and when $n=3$ or 4, then m is most likely 2. Evidently m and n are interrelated for the $Q^{\rm II}$ collisions.

On the other hand, if it is assumed that the second peak results from the situation wherein after collision one atom has the distribution I and the other has distribution III, the predicted distribution is

$$P_{mn}^{\;\rm II}=\tfrac{1}{2}(P_m^{\;\rm I}P_n^{\;\rm III}+P_m^{\;\rm III}P_n^{\;\rm I}). \tag{3}$$

This prediction is compared with the $Q^{\rm II}$ data in Fig. 2(b). Although the heights do not agree perfectly, the shapes and peak locations do agree with the predicted contours and the model appears to be correct.

These results suggest that there are only two excited intermediate levels, $A\sim50$ eV and $B\sim310$ eV, which can appear in each atom after collision. The three Q values correspond to $2A$, $A+B$, and $2B$, respectively. For relatively gentle collisions, where only the M shells interpenetrate, each atom is excited to state A

and only Q^{I} is seen. For rather violent collisions, where there is appreciable interpenetration of the L shells as well, each atom is excited to state B (a combination of M- and L-shell excitation) and only Q^{III} is seen. However, there is a critical region, at which the L shells just begin to touch, where Q^{I} and Q^{III} are both seen, and where Q^{II} evidently represents those cases where one atom leaves in state A and the other in state B.

Everhart and Kessel[4] showed that Q^{III}, here described as $2B$, is a rather broad distribution in Q whose center shifts upward with increase of either the incident energy or scattering angle. If A and B are each considered to be such a distribution,[4] then Eq. (3) is an over-simplification, because the P_n and P_m values are functions of Q within each class j. A more detailed mixing of I and III is required, involving an integral over both distributions. However, this refinement would not change the pattern of the above results.

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OBSERVATION OF TIME-DEPENDENT CONCENTRATION FLUCTUATIONS IN A BINARY MIXTURE NEAR THE CRITICAL TEMPERATURE USING A He-Ne LASER*

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Using a He-Ne laser homodyne spectrometer, we have observed for the first time the frequency spectrum of the time-dependent concentration fluctuations in a binary liquid mixture just above the critical temperature. The behavior of light scattered off these concentration fluctuations will be similar, at least qualitatively, to the scattering which results from density fluctuations in a pure liquid. When light is scattered from a pure liquid, spontaneous density fluctuations result in the appearance of a third unshifted line in addition to the usual Brillouin doublet.[1] This line was first observed by Gross[2] at temperatures well removed from the critical temperature, and explained by Landau and Placzek[3] who attributed it to the scattering of light by the unorganized thermal fluctuations in the entropy or temperature of the liquid at constant pressure. They predicted that the line should have a Lorentzian shape and that its width is a measure of the decay time of the spontaneous fluctuations. The predictions of the Landau-Placzek theory have never been carefully tested.

Pecora[4] has suggested that accurate information on the long-range part of the space-time correlation function governing concentration fluctuations could be obtained from experiments near the critical temperature in a binary liquid mixture where the spontaneous concentration fluctuations become large and slow; however, no detailed theory describing the spontaneous concentration fluctuations has been published. The recent development of a He-Ne laser homodyne spectrometer by Cummins, Knable, and Yeh[5] has made possible a detailed study of the central component.

The system studied in the present experiment is a cyclohexane-aniline mixture, 53% cyclohexane and 47% aniline by weight. The mixture is contained in a cylindrical glass cell in a constant-temperature enclosure, the temperature of which can be adjusted and held constant to about 1×10^{-3} °C over extended periods of time. Light of wavelength 6328 Å from a He-Ne laser is split into two beams and shifted in frequency from each other by a known amount by means of Bragg tanks.[6] One beam falls directly on the photocathode of a photomultiplier, together with light from the other beam which is first