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CORRELATION OF RESONANCE CHARGE EXCHANGE CROSS-SECTION DATA 
IN THE LOW-ENERGY RANGE

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During the course of a literature survey concerning resonance charge exchange, an unusual 
degree of agreement was noted between an extrapolation of the data reported by Kushnir, Palyukh, 
and Sena\textsuperscript{1} and the data reported by Ziegler.\textsuperscript{2} The data of Kushnir et al. are for ion-atom relative 
energies from 10 to 1000 ev, while the data of Ziegler are for a relative energy of about 1 ev. 
Extrapolation of the data of Kushnir et al. was made in accordance with Holstein's theory,\textsuperscript{3} which is a combination of time-dependent perturbation methods and classical orbit theory. The results 
of this theory may be discussed in terms of a critical impact parameter $b_c$. For impact pa-
rameters less than $b_c$, the theory says the probability of charge exchange $P$ is a rapidly oscil-
lating function of $b$ with extremes at 0 and 1 and an average value of $\frac{1}{2}$. For $b > b_c$, $P$ rapidly 
drops from $\frac{1}{2}$ to zero with increasing $b$. Holstein gives the expression for $P$ as a function of $b$ and 
relative energy $\epsilon$. Setting $P$ equal to $\frac{1}{2}$, he gets an equation for all the $b$'s where $P$ passes through $\frac{1}{4}$. If attention is restricted to the largest $b$, which 
is a solution to this expression, we have $b_c$ as a function of energy. If $b_c$ is used to compute a 
cross section ($\sigma = \pi b_c^2$), Holstein's theory gives
a charge exchange cross-section energy relationship of the form,

$$\epsilon = K_1 \epsilon^{1/2} \exp(-K_2 \epsilon^{1/2}),$$

where $K_1$ and $K_2$ are functions of the interaction potential. Note that, for a given $\epsilon$, $\alpha$ is double valued. The lower $\alpha$ value had no meaning as a cross section. It corresponds to one of the $b'$s less than $b_c$ where the oscillating $P$ passes through $\frac{1}{2}$. A curve of the form of the above equation was fitted to the data of Kushnir et al. These curves (corrected for polarization) are shown in Figs. 1 and 2 for Ar and Xe, respectively. The data of Ziegler are also shown in these figures.

The mobilities of Ar and Xe were computed according to Holstein using the extrapolated cross-section curves of Figs. 1 and 2. The computed values of mobility are compared in Table I with experimental values reported by Biondi and Chanin.

The agreement of the two sets of cross-section data with each other and with mobility data is unusually good when one considers the wide range of energy included in the correlation.

Table I. Mobility at 300°K.

<table>
<thead>
<tr>
<th></th>
<th>Mobility (cm$^2$/volt-sec)</th>
<th>Extrapolation of Kushnir, Palyukh, and Sena data$^b$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biondi and Chanin$^a$ (experimental)</td>
<td>Ars $^{1.6}$</td>
<td>1.50</td>
</tr>
<tr>
<td>Xe</td>
<td>0.595</td>
<td>0.453</td>
</tr>
</tbody>
</table>

$^a$See reference 4.

$^b$See reference 1.

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