The Low Frequency Double Vibrations of the Deutero-Ammonias

In the vibration spectrum of NH_3 the low frequency parallel band (ν_3) consists of two close components, due to the double minimum in potential energy with respect to the coordinate along the symmetry axis. If the form of this potential function were completely known, the distance between the two minima could be obtained from the separation of any pair of vibrational components, as Dennison and Uhlenbeck have shown.[1] This, together with the moment of inertia indicated by the fine structure, would make possible a complete determination of the interatomic distances from measurements on one band. Conversely, further information from the spectrum may serve to define more precisely the potential constants. Hence the measurement of these bands for the deutero-ammonias is of particular interest.

We have observed pairs of absorption maxima representing the zero branches of ν_3 for each of the four varieties of ammonia. These converge rapidly with increasing mass, but not as rapidly as would be predicted by the simple theory assuming infinitesimal amplitudes. This suggests that the effects of interaction are important in determining the separations. The two hybrid molecules are slightly assymetrical, of course, and would require some modification of the theoretical treatment. The positions of the observed absorption maxima in cm^{-1} and their separations are as follows:

NH_3	933	967	34
NH_2D	874	894	20
NHD_2	808	818	10
ND_3	745	748	3

The molecular dimensions can best be determined by a comparison of the moments of inertia of NH_3 and ND_3 as obtained from an analysis of the rotational structure of their parallel type bands. These observations are now almost complete and will be published shortly.

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[1] Dennison and Uhlenbeck, Phys. Rev. **41**, 313 (1932).
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Nuclear Reactions and Their Classification by Atomic and Isotopic Numbers

Since 1915 the writer has used the isotopic number (I) and the atomic number (Z) to exhibit the relations of atomic species and their transformations, and these variables have been found to give much more simple diagrams than those in which the atomic mass (M) and (Z) are used. The relations between some of the dependent variables involved have been presented by Harkins and Madorsky.[1] They give the formula of any nucleus as

$$(p_2e)_Z \quad (pe)_I, \tag{1'}$$

in which pe is taken as representing a neutron (page 137).

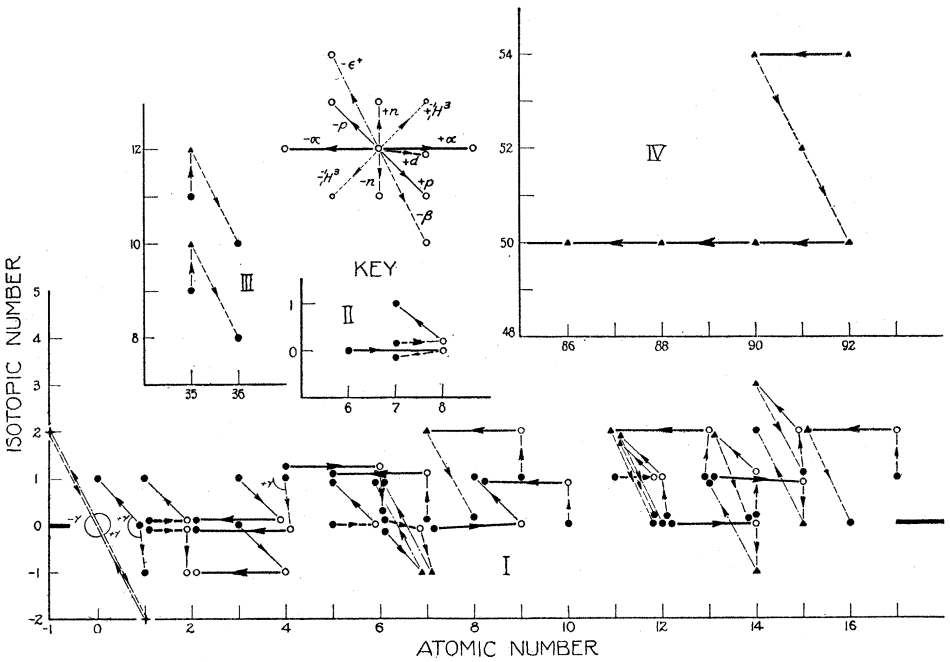

FIG. 1. Reactions of atomic nuclei. Black circles, initial or final stable nuclei; open circles, nuclei which disintegrate immediately on account of an excess of energy introduced with the projectiles and triangles, radioactive nuclei.