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Measuring the Internal Energies of Asymmetrical Diatomic Molecular Ions using a Three-Dimensional Imaging Technique

[1] D. A. RIVAS, C. I. GUILLEN, J. B. SAUZA, V. M. ANDRIANARIJAONA, Department of Physics, Pacific Union College, Angwin, CA 94508 — Our goal is to measure the vibrational state of a small asymmetrical diatomic molecular ion by observing the kinetic energy release through a resonant dissociative charge transfer. We will use an imaging technique similar to the one used for symmetrical diatomic ions (PRL 92 163004, 2004), which gives a direct access to the vibrational state distribution of the mother molecular ion. The two fragments hit two detectors which sense the positions and their time difference of impact. In the case of a symmetrical ion, the two daughter particles have the same velocity in the center of mass frame of reference and there is no reason to distinguish which particle hits the detector first and which one stops the stopwatch. The asymmetrical case is not the same because for a diatomic molecular ion such as HeH^+, the lighter fragment has a higher recoil velocity than the heavier fragment and goes transversely further away from the center of mass direction. Thus, the two fragments are naturally selected as the lighter cannot hit the first detector if the beam is judicially misaligned. Once we obtain the computed kinetic energy release then we may relate it to the vibrational excitation level of the initial asymmetrical ion. In addition details of this particular technique will be presented.

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