

Chapter 3. Molecular Physics

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3.1 Electric Neutrality of Molecules: Acoustic-Electric Neutrality Experiment

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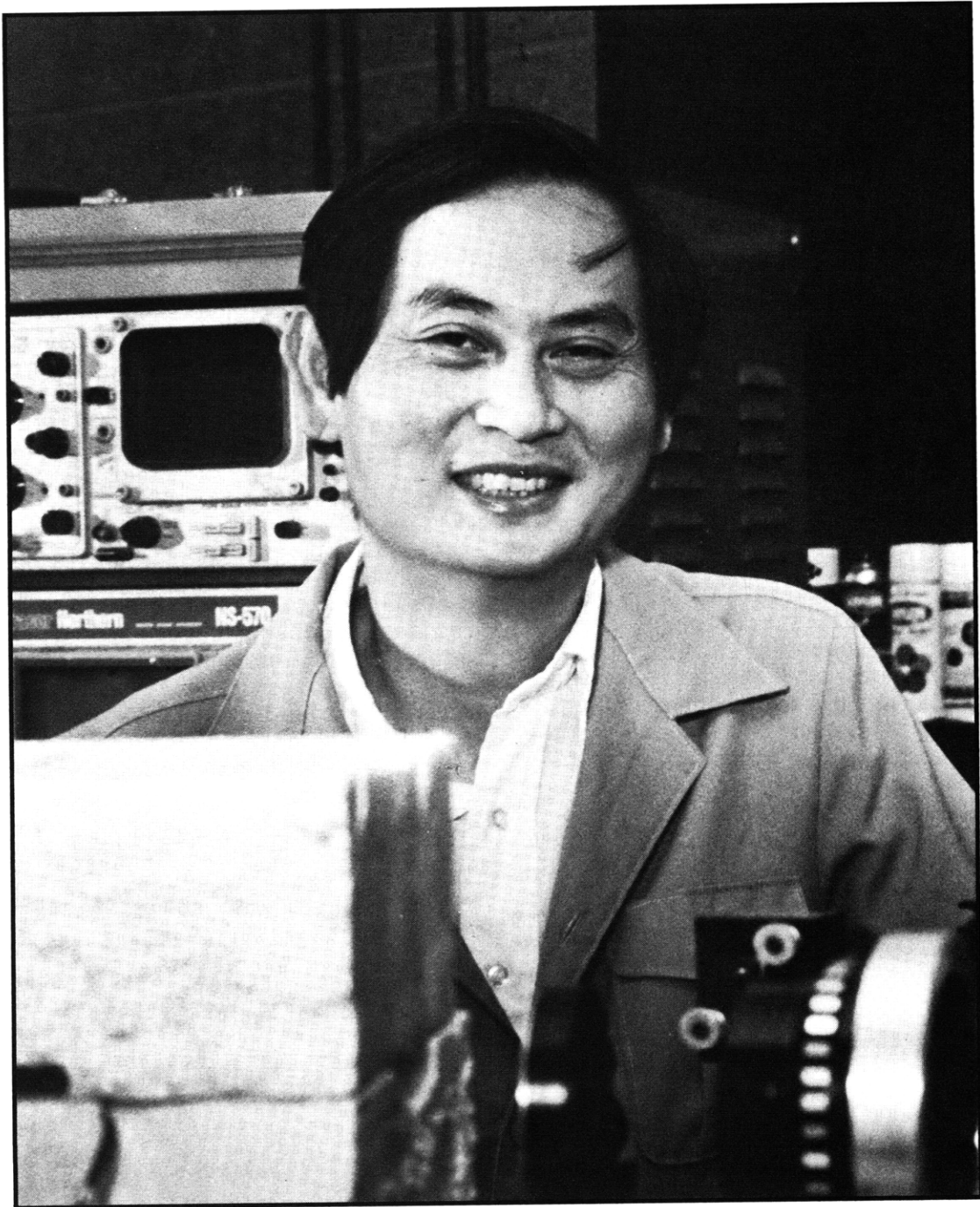
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We have completed the design of the first Acousto-electric neutrality experiment. In this experiment, an intense acoustical standing wave in a resonant chamber produces large density oscillations at the pressure maxima. Metal grids placed at these maxima would have an alternating charge induced on them if the gas were charged. By looking for alternating potential differences of the grids, limits can be placed on the induced charge and hence on the

hypothetical charge carried by the gas molecule. Our apparatus, a stainless steel cylinder approximately 2.5 meters long and 1 meter in diameter, will be driven at approximately 200 Hz (in the case of air) with a maximum pressure amplitude of 10^4 n/m². With suitable detection schemes and barring unforeseen artifacts, a limit on the charge per molecule of $< 10^{-25}e$ should be attainable, 10^5 times better than our previous limit.

Note that this Acousto-electric technique is the inverse of our earlier Electro-acoustic method,¹ where alternating electric fields in a resonant acoustic cavity would generate sound at the fundamental frequency if the gas were charged. In this method, second harmonic sound will also be generated through the induced electric dipole of the gas molecules if there are any gradients in the electric field. Fundamental sound will also be generated if there is impurity or asymmetry in the electric field waveform. The severe requirements on geometry and waveform limit the sensitivity of the method.

¹ Dylla and King, *Phys. Rev. A* 7:1224(1973); J. Berg, *A Measurement of the Electron Proton Charge Difference in Gaseous and Liquid Nitrogen*. S.B. thesis, Dept. of Physics, MIT, 1980.; B.N. Suggs, *The Electron-Proton Charge Anti-Symmetry: Improving the Acoustic Method*. S.B. thesis, Dept. of Physics, MIT, 1982; J. Thayer, *Investigation of a Possible Charge Unbalance Between the Electron and Proton*. S.B. thesis, Dept. of Physics, MIT, 1984.



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