



A negative ion is an atom or molecule that has more electrons than protons, giving it a net negative charge. Both negative and positive ions play key roles in many key chemical processes, but, until lasers were developed, there were no experimental methods available allowing quantitative investigations of their properties.

To study negative ions, Lineberger made use of the photoelectric effect—the emission of electrons, known as photoelectrons, that can occur in response to light. In Lineberger’s negative ion photoelectron spectroscopy apparatus, a beam of negative ions is sent through a vacuum where it intersects with an intense laser beam, producing photoelectrons. By analyzing the energy of those photoelectrons, scientists can determine the electron affinity of the neutral version of an atom or molecule. Electron affinity—the change in energy that occurs when an electron is added to an atom or molecule—provides important information about atoms and molecules and how they interact in chemical reactions. The “periodic table” of atomic electronic affinities now included in general chemistry textbooks is founded on Lineberger’s early work with negative ion photoelectron spectroscopy. His development of anion photoelectron spectroscopy as a tool to study small molecules has provided both an important method to characterize highly reactive, short-lived species known as free radicals and a new, direct way to observe the structure and evolution of reacting molecules in the process of undergoing a chemical reaction. His experimental methods are now in widespread use in laboratories worldwide.