

The Franck-Hertz Experiment and the Nature of Ionization

Clayton A. Gearhart

American Physical Society, April 2013

In 1914, James Franck and Gustav Hertz published their famous experiment in which they bombarded mercury atoms with slow electrons---the latest in a series of papers seeking both to measure the ionization potentials of different elements, and to understand the implications of the new quantum theory. They found peaks in the transmitted current separated by 4.9 volts, a result they interpreted as the ionization potential. But they also noticed that this voltage corresponded to a prominent resonance line in the ultraviolet spectrum of mercury, and immediately performed a second experiment that confirmed the presence of this spectral line. They concluded---surprisingly---that their collisions sometimes resulted in ionization, but other times in the excitation of an atomic electron that vibrated and emitted light at this wavelength. In 1914, Franck and Hertz did not know of Niels Bohr's new theory, which presented something close to our modern view of the relation between spectral terms and ionization potentials. In this paper, I will ask how Franck and Hertz, and other physicists, thought about ionization in the early years of quantum theory, before the advent of the Bohr model.