8.8: Autoionization and Dielectronic Recombination

The ionization energy as discussed until this point has meant the energy required to remove an electron from an atom, initially in its ground level, leaving the removed electron with no kinetic energy. The neutral atom has a number of discrete energy levels below the ionization limit; above that limit, there is a continuum of energy states - which merely means that the electron is unbound and there are no restrictions on its kinetic energy.

However, it is possible for more than one electron in an atom to be excited, and in that case it is quite possible for an atom to exist in a discrete bound level whose energy is above the ionization limit as described in the previous paragraph. Although this is quite possible, an atom generally does not stay long in one of these highly excited levels. One of the electrons can easily slip away from the atom without the absorption of any additional energy, thereby leaving behind an ion in an excited state. Such a process is called *autoionization*, and the levels or states concerned are autoionization levels or states.

The converse process is quite possible. An ion in an excited state can capture a hitherto free electron, thus forming the neutral atom with two excited electrons. The process is *dielectronic recombination*. Downward transitions from these autoionization levels to lower discrete level can occur.

As mentioned above, the mean lifetime of the atom in one of these autoionization levels is rather short. As a consequence of Heisenberg's uncertainty principle, there is a corresponding uncertainty in the energy level that is inversely proportional to the lifetime. Stated otherwise, the autoionization energy levels are relatively broad. Consequently lines resulting from downward transitions originating from these autoionization levels are relatively broad, and indeed such lines are often recognized or at least suspected from their relatively diffuse appearance. Such lines are readily observed, for example, in the spectra of copper, zinc and cadmium among others.