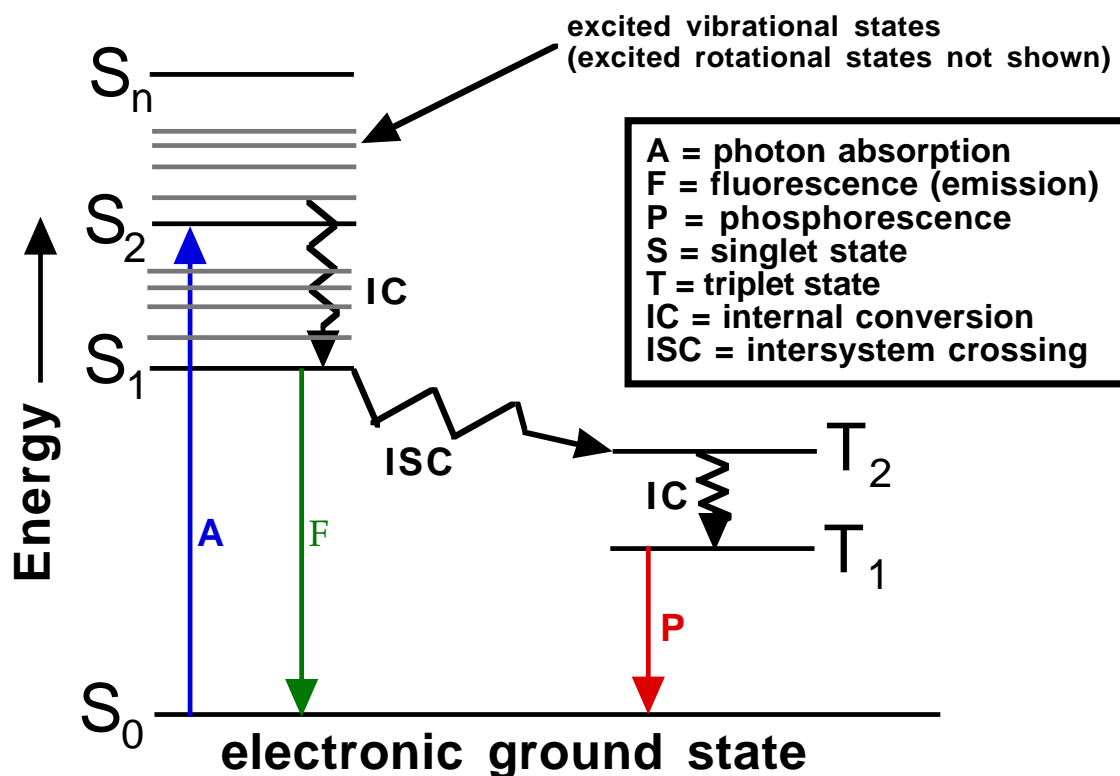


Jablonski Diagram

Relaxation mechanism for excited state molecules

Once a molecule has absorbed energy in the form of electromagnetic radiation, there are a number of routes by which it can return to ground state (the statistically most common energy state for room temperature chemical species). The following graphic, termed a Jablonski diagram, shows a few of these processes.

Jablonski diagram:



If the photon emission (shown in short wavelength blue in the diagram) occurs between states of the same spin state (e.g. $S_1 \rightarrow S_0$) this is termed fluorescence. If the spin state of the initial and final energy levels are different (e.g. $T_1 \rightarrow S_0$), the emission is called phosphorescence (shown in longer wavelength red). Since fluorescence is statistically much more likely than phosphorescence, the lifetimes of fluorescent states are very short (1×10^{-5} to 10^{-8} seconds) and phosphorescence somewhat longer (1×10^{-4} seconds to minutes or even hours; think about glow-in-the-dark flying disks).

Three nonradiative deactivation processes are also significant here: internal conversion (IC), intersystem crossing (ISC) and vibrational relaxation. Examples of the first two can be seen in the diagram. Internal conversion is the **radiationless** transition between energy states of the same spin state (compare with fluorescence—a radiative process). Intersystem crossing is a radiationless transition between different spin states (compare to phosphorescence). Vibrational relaxation, the most common of the three—for most molecules, occurs very quickly ($<1 \times 10^{-12}$ seconds) and is enhanced by physical contact of an excited molecule with other particles with which energy, in the form of vibrations and rotations, can be transferred through collisions. This means that most excited state molecules never emit any energy because in liquid samples the solvent or, in gas phase samples, other gas phase molecules that are present “steal” the energy before other deactivation processes can occur.

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