RADIATIVE AND NON RADIATIVE TRANSITION

PREREQUISITE

- Types of excitation and Jablonski diagram
- Ground state and excited state

LEARNING OUTCOMES

- Knowledge of Jablonski diagram
- Electronic energy state
- Absorbance and photochemical phenomenon
- Knowledge of fluorescence and phophoresence

ABSORBANCE / PRIMARY PROCESS

- When electron present in ground state S_0 , it absorb energy from photon and excited to higher excited state may be S_1 S_2, etc. This process is known as absorbance or primary process.

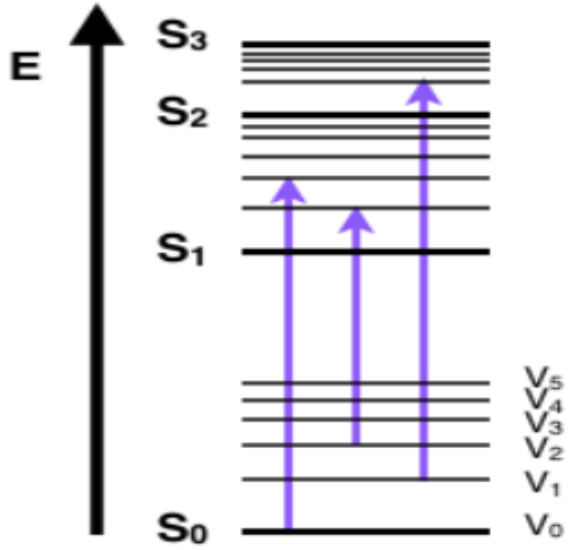


Figure 2: *Three possible absorption transitions represented.*

SECONDARY PROCESS

VIBRATIONAL RELAXATION AND INTERNAL CONVERSION

- Once an electron is excited, there are a multitude of ways that energy may be dissipated. The first is through vibrational relaxation, a non-radiative process
- . This is indicated on the Jablonski diagram as a curved arrow between vibrational levels
- . Vibrational relaxation is where the energy deposited by the photon into the electron is given away to other vibrational modes as kinetic energy.
- This relaxation occurs between vibrational levels, so generally electrons will not change from one electronic level to another through this method.

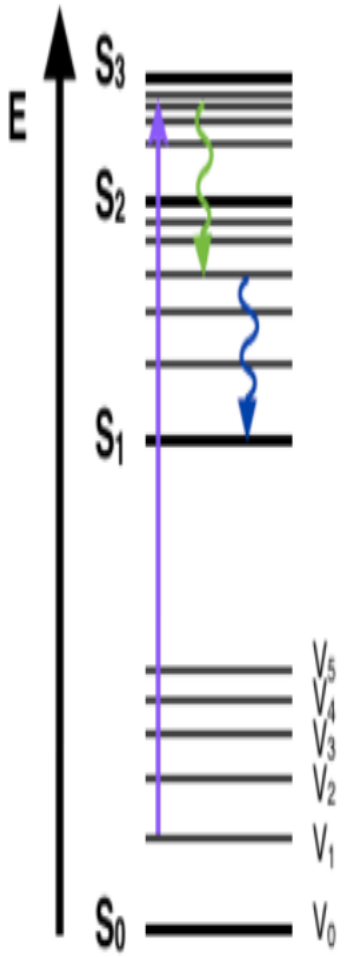


Figure 3: Possible scenario with absorption, internal conversion, and vibrational relaxation *processes shown.*

Fluorescence

- Fluorescence is most often observed between the first excited electron state and the ground state
- While this transition is slow, it is an allowed transition with the electron staying in the same multiplicity manifold.
- Fluorescence is a slow process on the order of 10^{-9} to 10^{-7} seconds

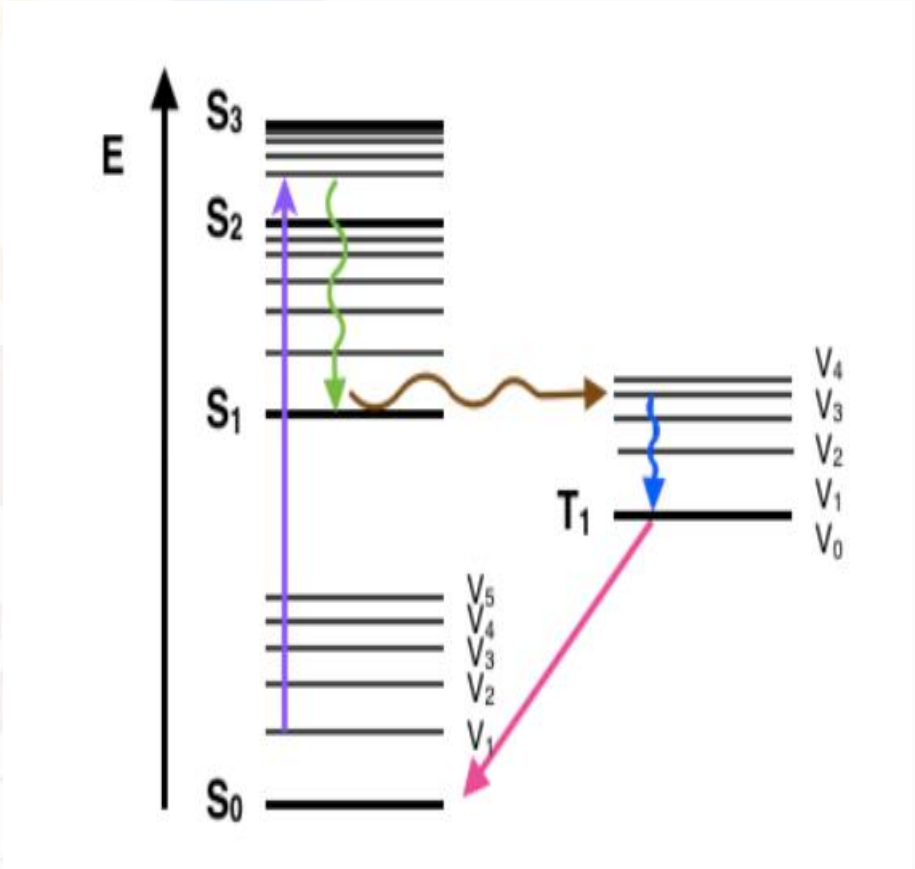
Intersystem Crossing / PHOSPHORESENCE

❖the electron changes spin multiplicity from an excited singlet state to an excited triplet state.

❖ This is the slowest process in the Jablonski diagram, several orders of magnitude slower than fluorescence.

❖Intersystem crossing leads to several interesting routes back to the ground electronic state

❖ One direct transition is phosphorescence, where a radiative transition from an excited triplet state to a singlet ground state occurs



Time Scales

Transition	Time Scale	Radiative Process?
Internal Conversion	10^{-14} - 10^{-11} s	no
Vibrational Relaxation	10^{-14} - 10^{-11} s	no
Absorption	10^{-15} s	yes
Phosphorescence	10^{-4} - 10^{-1} s	yes
Intersystem Crossing	10^{-8} - 10^{-3} s	no
Fluorescence	10^{-9} - 10^{-7} s	yes

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