

Each level is indexed by l and v !

For example: level $v=0, l=1$ is different from level $v=1, l=1$, etc...

Optical transitions are subject to selection rules:

$$\left. \begin{array}{l} \Delta l = \pm 1 \\ \Delta v = \pm 1 \end{array} \right\} \text{simultaneously.}$$

→ Pure vibrational transition cannot occur!
 ← rotational " " " " !

In order to have a transition, say to higher level, the absorbed photon energy is:

$$\Delta E = h\nu + \frac{h^2}{2I_{cm}} 2(l+1) \quad \Delta l = +1$$

$$\Delta E = h\nu - \frac{h^2}{I_{cm}} l \quad \Delta l = -1$$

example

transition
 $v=0, l=1$
 $v=1, l=2$

example

transition
 $v=0, l=3$
 $v=1, l=2$