508(2): Total Number of Frequencies:

This note shows the total number of Evans/Morris frequencies in the series $n' = 2$ to $n = 3$, $n' = 3$ to $n = 4$ and so on i.e. n' to $n' + 1$ in all polarizations, including linear. For the red line, $n' = 2$ and $n = 3$, and at the non-relativistic level, the relevant quantum numbers are:

1) $n = 2, \ell = 0, m = 0,$
2) $n = 2, \ell = 1, m = -1, 0, 1,$
3) $n = 3, \ell = 0, m = 0,$
4) $n = 3, \ell = 1, m = -1, 0, 1,$
5) $n = 3, \ell = 2, m = -2, -1, 0, 1, 2.$

The selection rules are:

$$\text{any } \Delta n, \ \Delta\ell = \pm 1, \ \Delta m = 0, \pm 1 \quad -(1)$$

For absorption in linear polarization from $n' = 2$ to $n = 3$

$$\Delta n = 1, \ \Delta\ell = \pm 1, \ \Delta m = 0 \quad -(2)$$

so there are five frequencies:

) $n = 2, \ell = 0, m = 0$ to $n = 3, \ell = 1, m = 0$
) $n = 2, \ell = 1, m = 0$ to $n = 3, \ell = 0, m = 0$
$n = 2, \ell = 1, m = 0$ to $n = 3, \ell = 2, m = 0$
$n = 2, \ell = 1, m = -1$ to $n = 3, \ell = 2, m = -1$
$n = 2, \ell = 1, m = 1$ to $n = 3, \ell = 2, m = 1$

) In left circular polarization for absorption from $n' = 2$ to $n = 3$ the five frequencies are:

) $n = 2, \ell = 0, m = 0$ to $n = 3, \ell = 1, m = 1$

) $n = 2, \ell = 1, m = -1$ to $n = 3, \ell = 0, m = 0$

) $n = 2, \ell = 1, m = -1$ to $n = 3, \ell = 2, m = 0$

) $n = 2, \ell = 1, m = 0$ to $n = 3, \ell = 2, m = 1$

) $n = 2, \ell = 1, m = 1$ to $n = 3, \ell = 2, m = 2$.

and the selection rules are:

$$\Delta n = 1, \quad \Delta \ell = \pm 1, \quad \Delta m = 1 \quad -(3)$$

In right circular polarization for absorption from $n' = 2$ to $n = 3$ the five frequencies are:

a) $n = 2, \ell = 0, m = 0$ to $n = 3, \ell = 1, m = -1$

b) $n = 2, \ell = 1, m = 1$ to $n = 3, \ell = 0, m = 0$

c) $n = 2, \ell = 1, m = -1$ to $n = 3, \ell = 2, m = -2$

d) $n = 2, \ell = 1, m = 0$ to $n = 3, \ell = 2, m = -1$

e) $n = 2, \ell = 1, m = 1$ to $n = 3, \ell = 2, m = 0$

and the selection rules are:

$$\Delta n = 1, \quad \Delta \ell = \pm 1, \quad \Delta m = -1 \quad (4)$$

So the total number of observable frequencies is

$$3(n'^2 + 1) = 15, \quad -(5)$$

five for each state of polarization.