# SP-1(C) : TANABE-SUGANO (TS) DIAGRAMS

An alternative method is to use Tanabe Sugano diagrams, which are able to predict the transition energies for both spin-allowed and spin-forbidden transitions, as well as for both strong field (low spin), and weak field (high spin) complexes.

In this method the energy of the electronic states are given on the vertical axis and the ligand field strength increases on the horizontal axis.

Linear lines are found when there are no other terms of the same type and curved lines are found when 2 or more terms are repeated. This is as a result of the "non-crossing rule".

The baseline in the Tanabe-Sugano diagram represents the lowest energy or ground term state.

**Example-1**: **The $d^2$ ion** ($V^{3+}$, V(III) ion )

$\nu_1$=17400 $cm^{-1}$, $\nu_2$=25400 $cm^{-1}$ and $\nu_3$=34500 $cm^{-1}$.

These have been assigned to the following *spin-allowed* transitions.

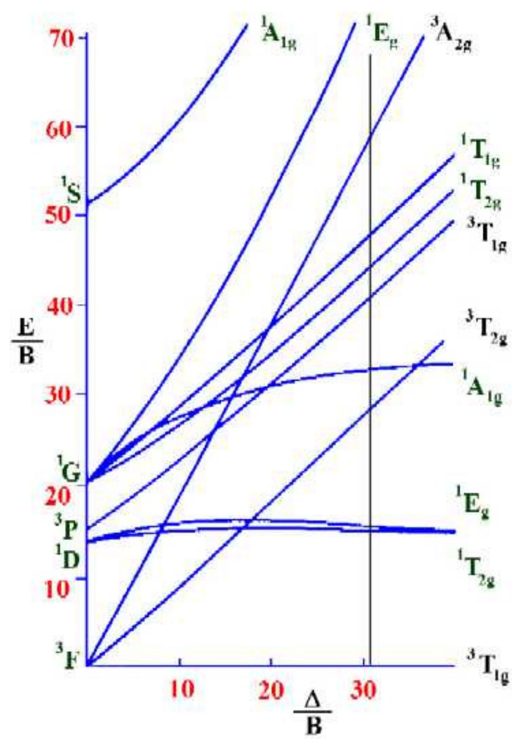
$^3T_{1g} \rightarrow {}^3T_{2g}$

$^3T_{1g} \rightarrow {}^3T_{1g}(P)$

$^3T_{1g} \rightarrow {}^3A_{2g}$



***Tanabe-Sugano diagram for $d^2$ complexes***



**Example 2**: The $d^3$ ion ($Cr^{3+}$ ion in $[Cr(H_2O)_6)]^{3+}$

$v_1$=17000 $cm^{-1}$, $v_2$ =24000 $cm^{-1}$ and $v_3$=37000 $cm^{-1}$.

*Refer Tanabe-Sugano diagram for $d^3$ octahedral complexes*

Order of increasing Energy of absorption

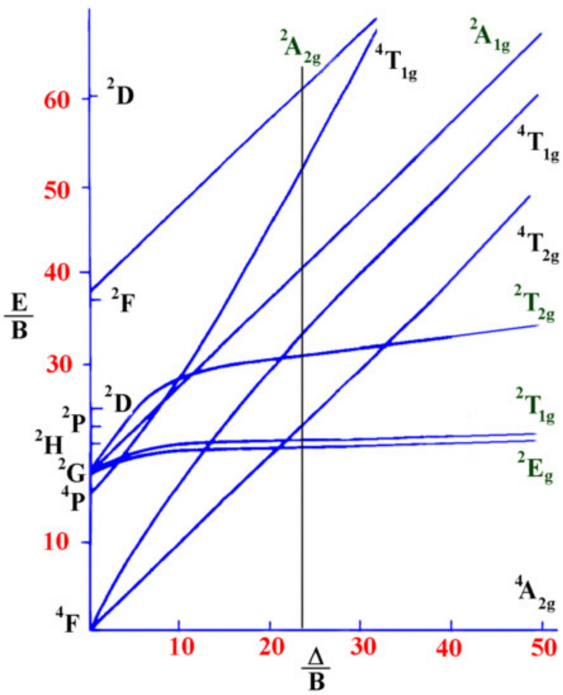
$v_1$=17000 $cm^{-1}$ < $v_2$ =24000 $cm^{-1}$ < $v_3$=37000 $cm^{-1}$.

These values have been assigned to the following spin-allowed transitions.

$^4A_{2g} \rightarrow$ $^4T_{2g}$ ……….($v_1$ )

$^4A_{2g} \rightarrow$ $^4T_{1g}$ ……….($v_2$ )

$^4A_{2g} \rightarrow$ $^4T_{1g}(P)$ …….($v_3$ )




*$d^3$ Complexes*