TS diagram plots energy dependence of term with field strength for a given B/C ratio. Both term energy and field strength are normalized to B. The lowest energy term is set = 0... so for hs/ls systems, there will be a discontinuity.

Let's consider electronic spectra of aquo complexes of first row TMs

$^{d^1}, \text{Ti}^{3+} (\lambda_{\text{max}} = 20300 \text{ cm}^{-1}, \varepsilon \sim 4 \text{ M}^{-1}\text{cm}^{-1})$

only one possible transition (the shoulder in the spectrum is due to Ti(H$_2$O)$_5$(OH)$_2^{2+}$)... so this is a trivial solution

$\frac{E}{B} = 10 \text{ Dq} = 20300 \text{ cm}^{-1}, \text{ Dq} = 2030 \text{ cm}^{-1}$
\(d^9, \text{Cu}^{2+} (\lambda_{\text{max}} = 12000 \text{ cm}^{-1}, \varepsilon \sim 11 \text{ M}^{-1}\text{cm}^{-1})\)

again expect only one band, but clearly there are two... this due to a Jahn-Teller distortion

Jahn-Teller effect - a molecule with an orbitally degenerate ground state will distort to remove the degeneracy and consequently lower its overall energy

Generally, a JT effect most pronounced when M-L \(\sigma^*\) orbitals are involved.
d², V³⁺ (λ_{max} = 17200 cm⁻¹, ε ~ 6 M⁻¹cm⁻¹; λ_{max} = 25600 cm⁻¹, ε ~ 8 M⁻¹cm⁻¹) from d² configuration, get terms of ^3F, ^1D, ^3P, ^1G and ^1S ... spin allowed transition (ΔS = 0) will prevail (i.e., be the most intense). Thus we will assume that transitions are between states from the terms, of ^3F and ^3P since the ^3F is the ground state

\[
\begin{align*}
^2P & \quad \cdots \quad ^3T_{1g} \\
^3A_{2g} \quad & \quad 10 \text{ Dq} \\
^3F & \quad \cdots \quad ^3T_{2g} \quad 8 \text{ Dq} \\
& \quad \cdots \quad ^3T_{1g}
\end{align*}
\]

this corresponds to a 2e⁻ transition... therefore transitions to this state should be exceptionally weak (due to low absorption cross-section... i.e. isospacial and isotemporal is very unlikely

Most reasonable assignments therefore are:

\[
\frac{E(\text{^1T}_{1g}(P) \leftarrow ^3\text{T}_{1g}(F))}{E(\text{^1T}_{2g}(F) \leftarrow ^3\text{T}_{1g}(F))} = \frac{25600}{17200} = 1.49
\]

From the TS diagram, this ratio is best fit at Dq/B = 2.8. At this energy value

\[
\frac{E(\text{^1T}_{2g}(F))}{B} = \frac{25.9 \times 17,200 \text{ cm}^{-1}}{B} \quad \text{or} \quad B = 664 \text{ cm}^{-1}
\]

\[
\frac{E(\text{^1T}_{1g}(P))}{B} = \frac{38.7 \times 25,600 \text{ cm}^{-1}}{B} \quad \text{or} \quad B = 661 \text{ cm}^{-1}
\]

B_{avg} = 663 cm⁻¹
$\frac{Dq}{B} = 2.8 \Rightarrow Dq = 2.8(B) = 2.8(663 \text{ cm}^{-1}) = 1860 \text{ cm}^{-1}$

Thus $10Dq = 18600 \text{ cm}^{-1}$

From the fit Dq and B values, may now determine energies of all other transitions (including the spin for hidden ones) of $V(H_2O)_6^{3+}$. The 2e$^-$ transition should fall at...

$$\frac{E(3A_g(F) \leftarrow 3T_{1g}(F))}{B} = 54 \text{ at } Dq/B = 2.8$$

$$E(3A_{2g}(F) \leftarrow 3T_{1g}(F)) = 54 (662 \text{ cm}^{-1}) = 35800 \text{ cm}^{-1}$$

Note: the B value for $V^{3+}$ complexed by $H_2O$ is smaller than the free ion value of 860 cm$^{-1}$. Remember B is a measure of the interelectronic repulsion in the complex, the metal d orbitals mix with the ligand orbitals. Owing to the covalency, the spatial dimension of the orbitals in which the d-electrons
...since operator for interelectronic repulsion goes as \( \frac{1}{r_{ij}} \) as 

\( r_{ij} \) increases, interelectronic repulsion decreases and hence B decreases.