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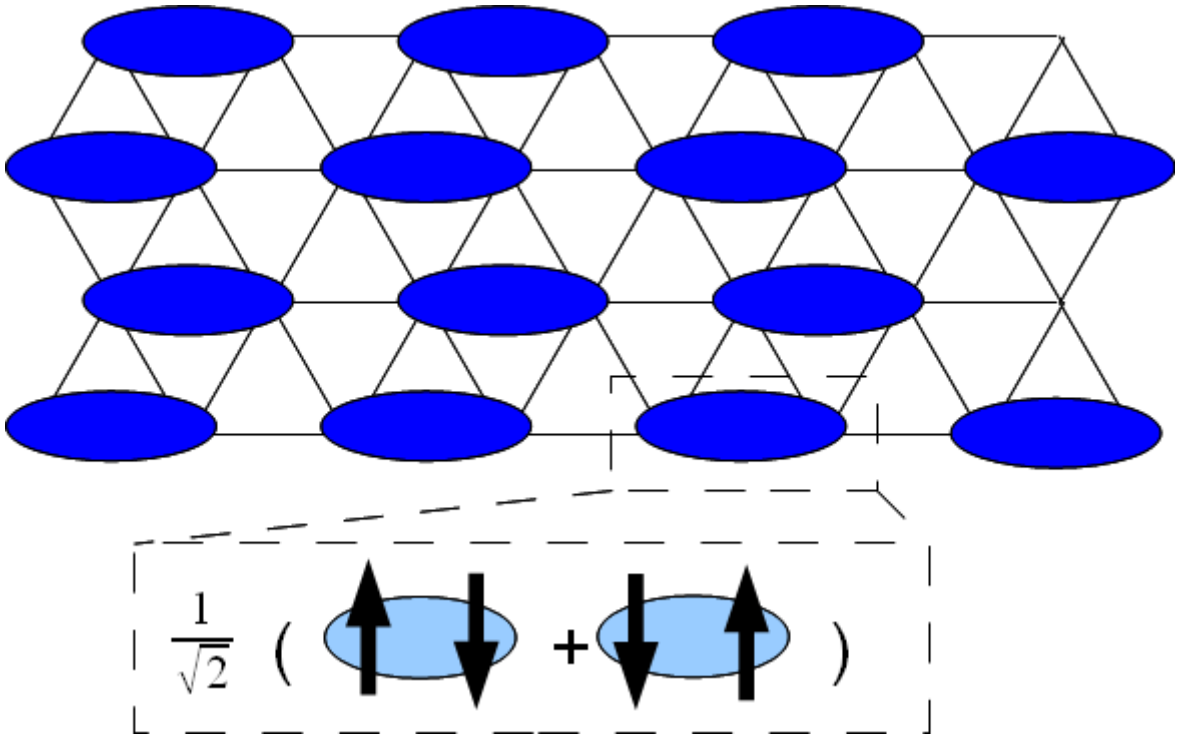
Valenced Bond Theory

Werner's theory failed to explain the directional properties of bonds in coordination and many other properties. As a result, this theory was not much accepted. Later on, valence bond theory was used to explain the structure of coordination compounds and the bond linkages. According to valence bond theory, the metal atom or ion under the influence of ligands can use its (n-1)*d*, n*s*, n*p*, n*d* orbitals for hybridization to yield a set of equivalent orbitals of definite geometry such as octahedral,tetrahedral, square planar etc. The hybridized orbitals can overlap with the ligand orbitals that can donate electron pairs for bonding.



Valence Bond Theory

Let us take an example of diamagnetic octahedral complex $[Co(NH_3)_6]^{3+}$, cobalt ion has the electronic configuration of $3d^6$. The hybridization scheme is seen as,

Orbitals of Co^{+3} ion:

d^2sp^3 hybridised orbitals of Co^{3+} can be viewed as,

d^2sp^3 hybrid

As the compound doesn't contain any unpaired electron it is diamagnetic in nature. All the six pairs of electrons from NH_3 molecules occupythe six hybridized orbitals. Since the inner *d* orbital (3*d*) is used in hybridization, the complex, $[Co(NH_3)_6]^{3+}$ is known as inner orbital or low spin or spinpaired complex. The paramagnetic octahedral complex generallyuses outer orbital (4*d)* in hybridization (sp^3d^2). It is known asouter orbital or high spin or spin free complex.

Limitations of Valence Bond Theory:

- Valence bond theory does not give a quantitative interpretation of magnetic data.
- It fails to explain the colour exhibited by coordination compounds.
- It does not give a quantitative interpretation of the thermodynamic or kinetic stabilities of coordination compounds.
- Predictions made by valence bond theory regarding the tetrahedral and square planar structures of 4-coordinate complexes are not accurate.
- It fails to distinguish between weak and strong ligands