Hybridization: **When two or more orbitals of almost equivalent energy combine together, equal number of degenerate orbitals are formed. This process is called Hybridization.**

Type of Hybridization:

1. **SP**
2. **SP^2**
3. **SP^3**
4. **SP^2d**
5. **SP^3d^2**
6. **SP^3d^3**

About Hybridization:

- Generally, the shape of a compound depends on the Hybridization of its central atom.

- Orbitals with almost equal energy at the outermost shell of the central atom participate in the Hybridization process.

- Only orbitals with electrons at the outermost shell of the central atom will participate in the hybridization.
  That is, orbitals without electrons do not participate in the hybridization.

- Only hybrid orbitals that have odd or uneven electrons will participate to form covalent bonds.

- The size, shape, strength and properties of hybrid orbitals are similar.

Fig: Iron Ball (3kg)

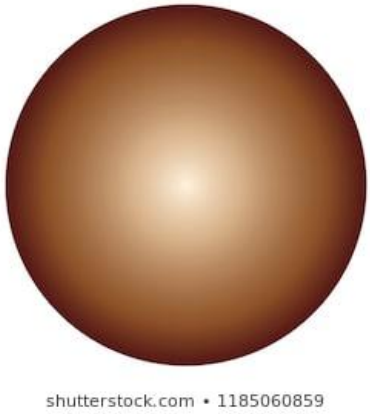


Fig: Cuper Ball (6 kg)

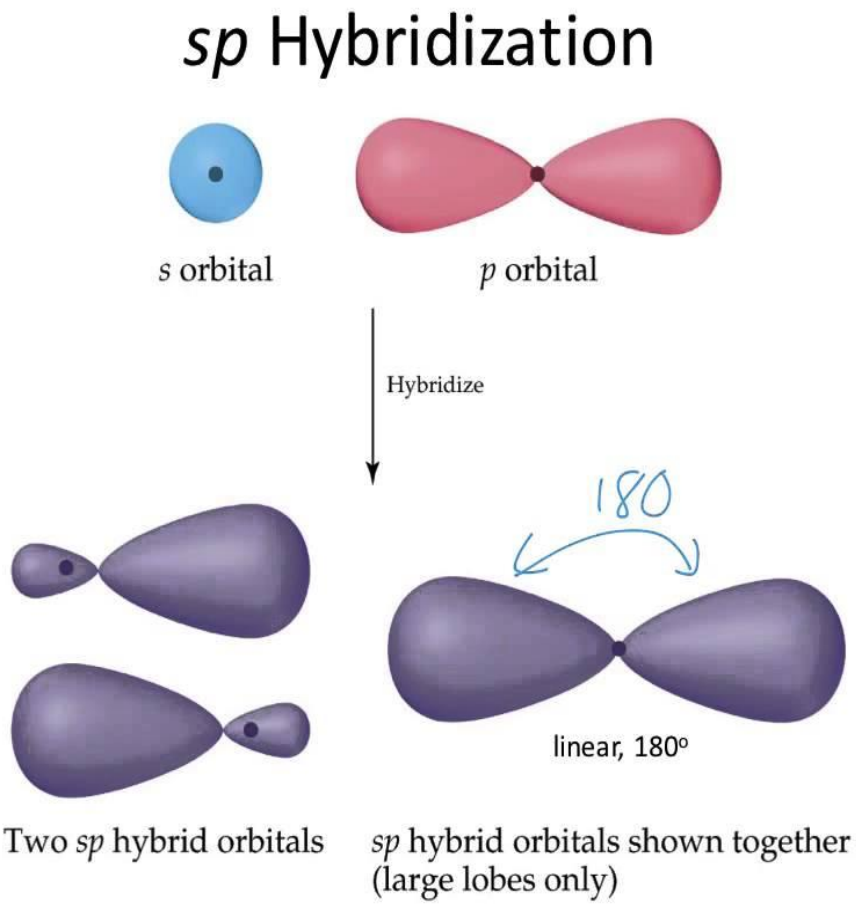
Fig: Zinc Ball (2 kg)

Fig: Gold Ball (1 kg)

Fig: Hybrid Ball (4 kg)

❖ SP Hybridization process and geometrical shape of $(BeCl_2)$ molecule:

SP Hybridization: In the valence shell of an atom, when one s-orbital mixes with one p-orbital to form two hybrid orbitals of equivalent energy is called SP Hybridization



Bond angle: 180^0

Shape: Linear

$BeCl_2$ AYyi msKiY cÖwµqv t

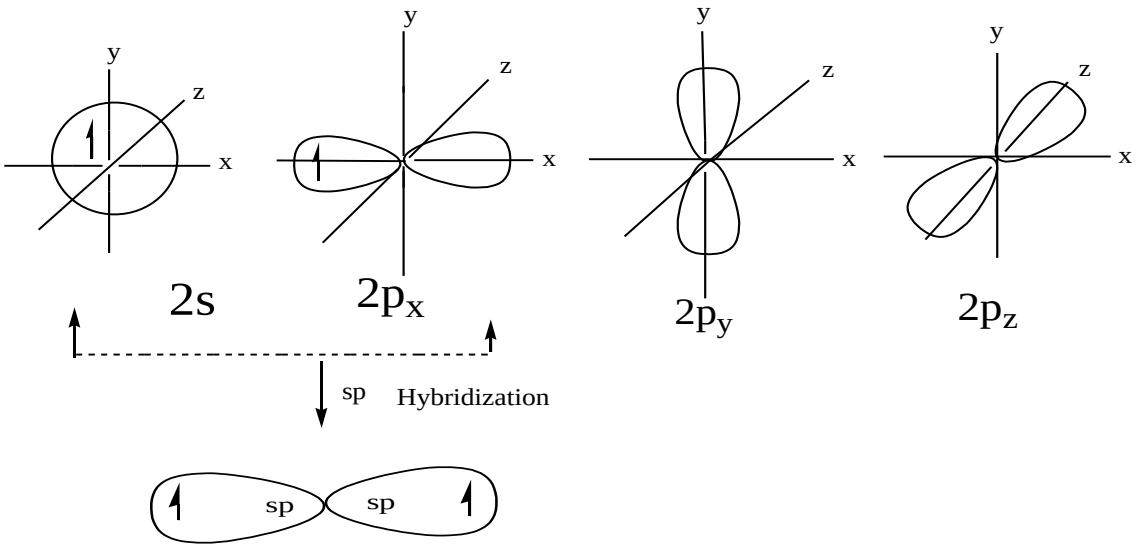
In $BeCl_2$ molecule, the central atom is Be

The ground state electron configuration is-

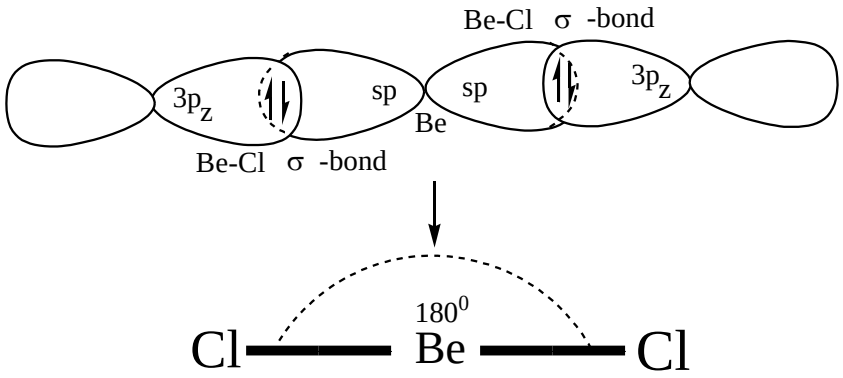
$_4Be = 1s^2\ 2s^2$

$_4Be^* = 1s^2\ 2s^1\ 2p_x^{\ 1}\ 2p_y^{\ 0}\ 2p_z^{\ 0}$ (at excited state)

Two linear sp hybrid orbitals are formed when 2s orbital mixes with one $2p_x$ orbital. [Here the other two p orbitals ($2p_y$, $2p_z$) do not take part in hybrid orbital formation.]

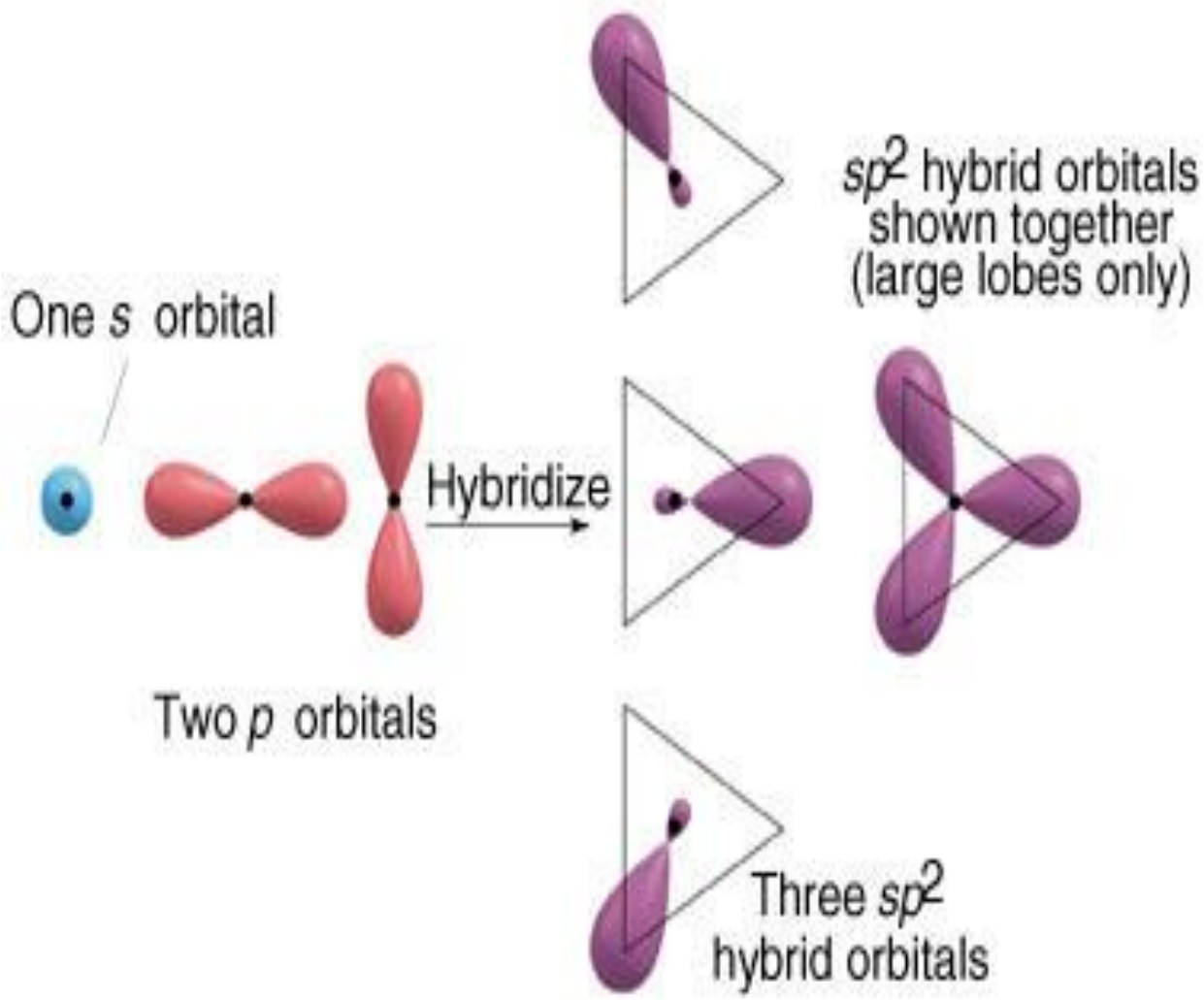


After forming two sp hybride orbitals, Be participate two covalent bond with two chlorine $3p_z$ orbitals separately and finally form $BeCl_2$ molecule. Where bond angle is 180^0



❖ SP^2 Hybridization process and geometrical shape of (BF_3) molecule:

SP^2 Hybridization:



Bond angle: 120^0

Shape: Trogonal Planar

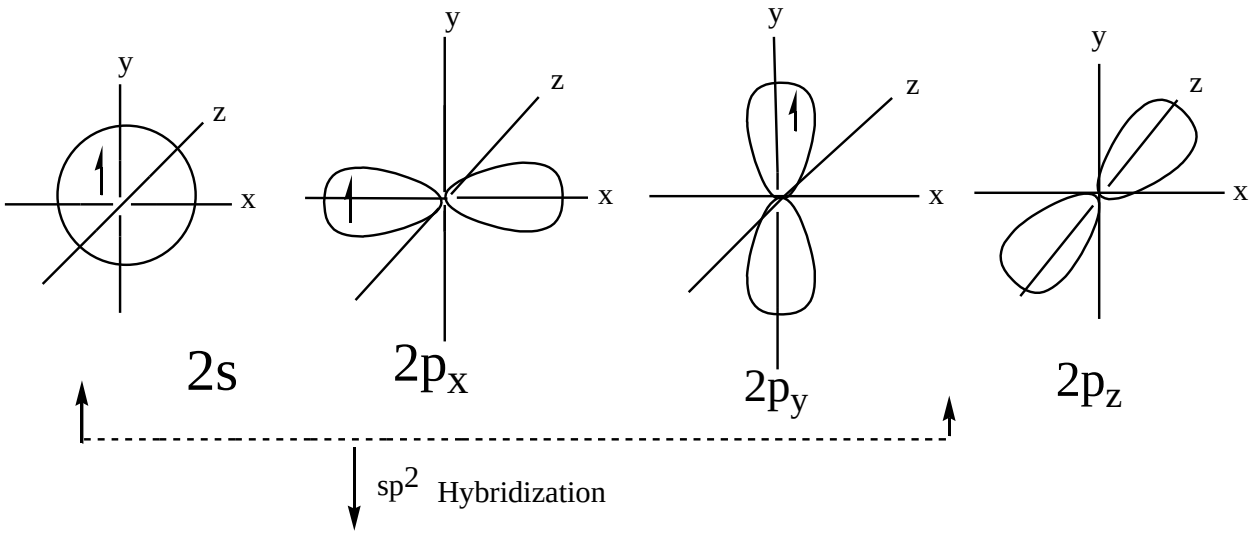
In BF_3 molecule, the central atom is B

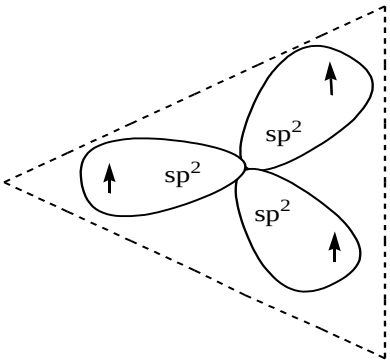
The ground state electron configuration is-$2p_x$

$_5B = 1s^2\ 2s^2\ 2p_x^1$

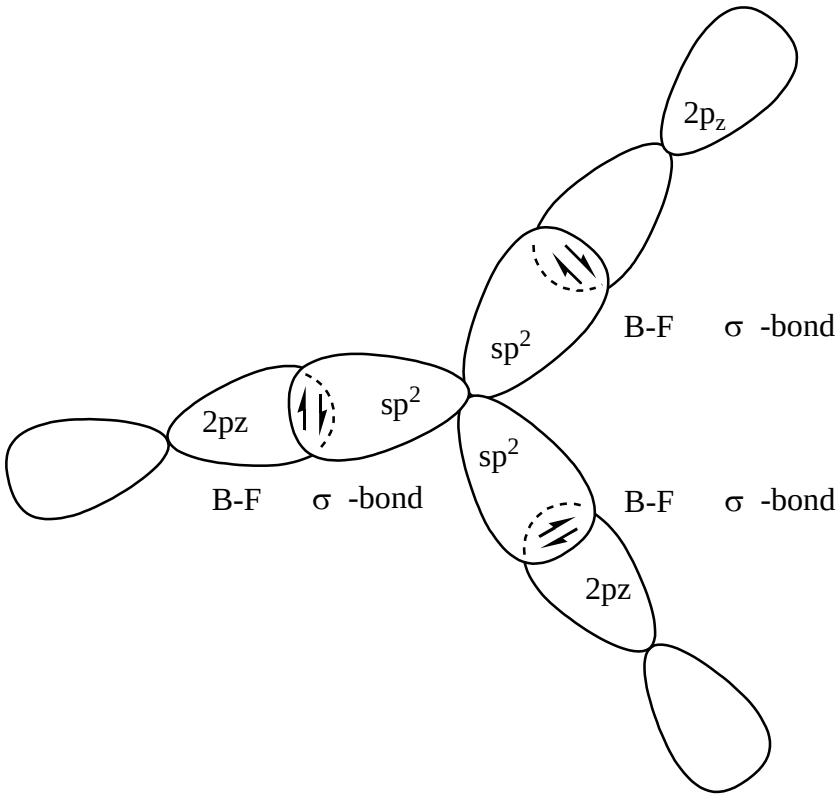
$_5B^* = 1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^0$ (at excited state)

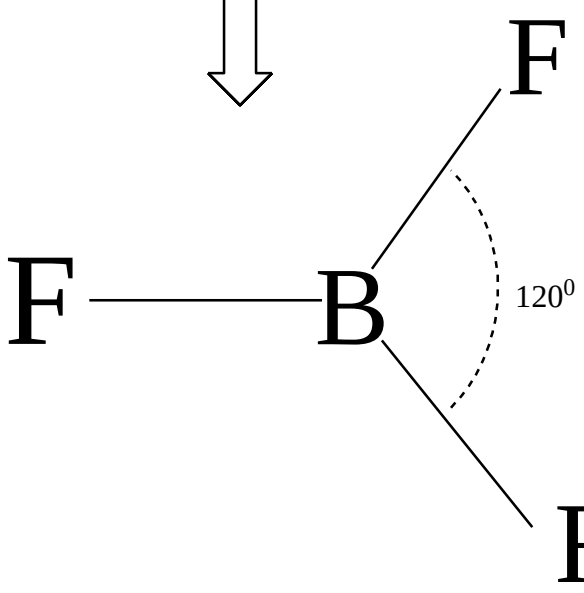
Three sp^2 hybrid orbitals are formed when 2s orbital mixes with two $2p_x$, $2p_y$ orbitals. [Here the another p orbital ($2p_z$) do not take part in hybrid orbital formation.]





After forming three sp^2 hybride orbitals, B participate three covalent bond with three Flurine $2p_z$ orbitals separately and finally form BF_3 molecule. Where bond angle is 120^0


2p$_z$
B-F σ -bond
sp^2
2pz
sp^2
sp^2
B-F σ -bond
B-F σ -bond
2pz


F
F
B
120^0
F

❖ SP^3 Hybridization process and geometrical shape of Methane (CH_4) molecule:

SP^3 Hybridization:

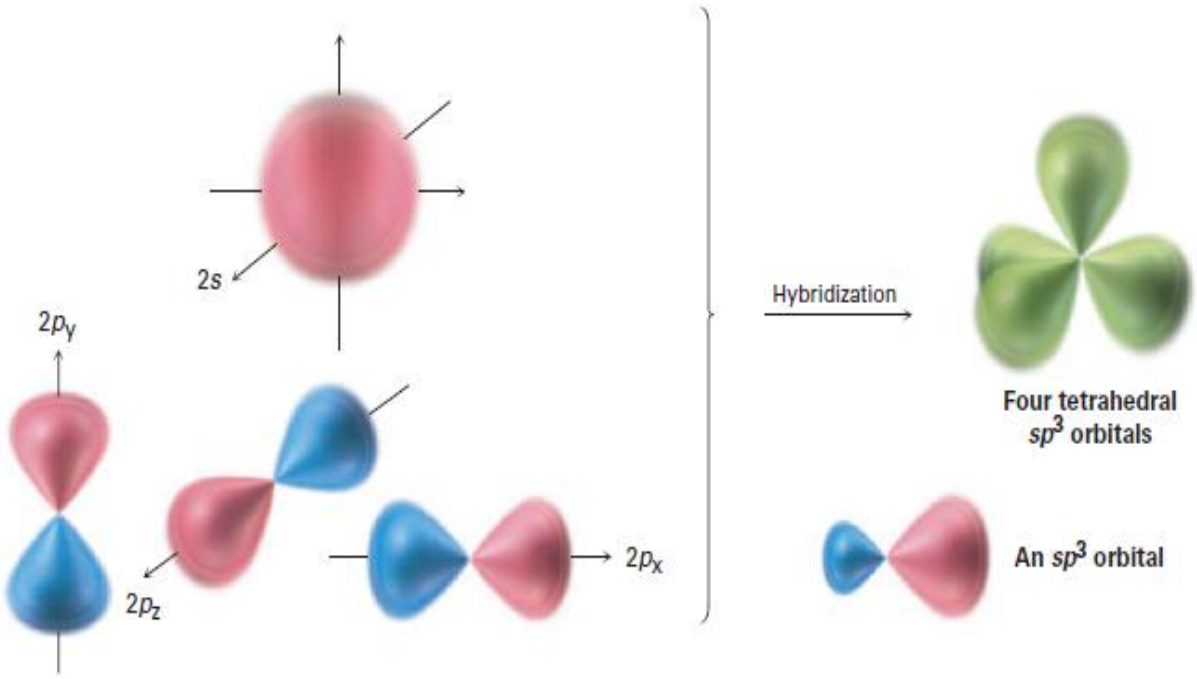
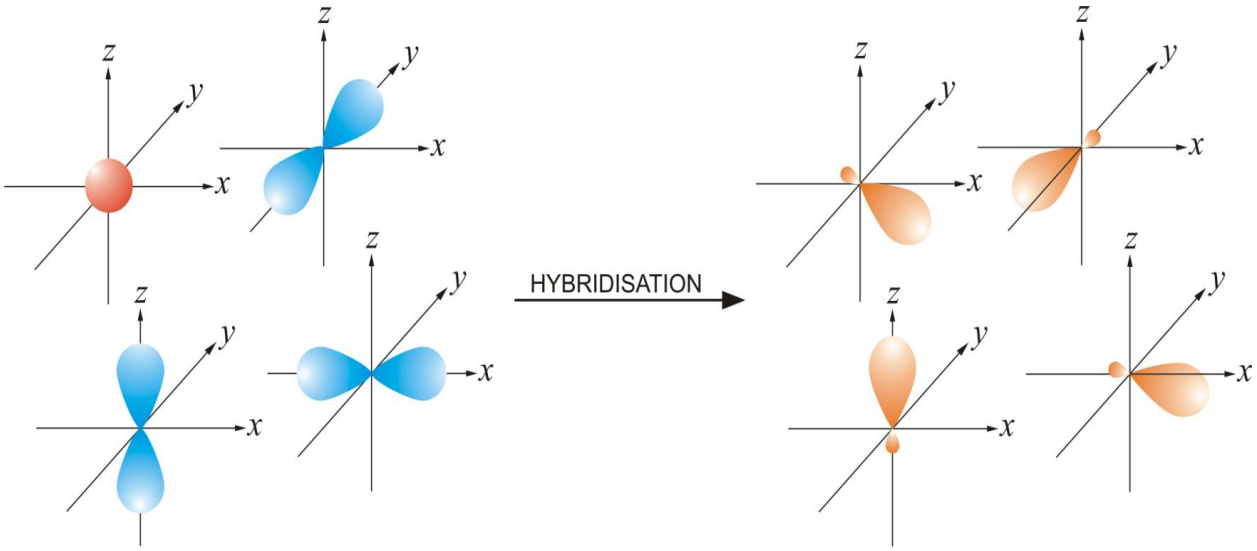
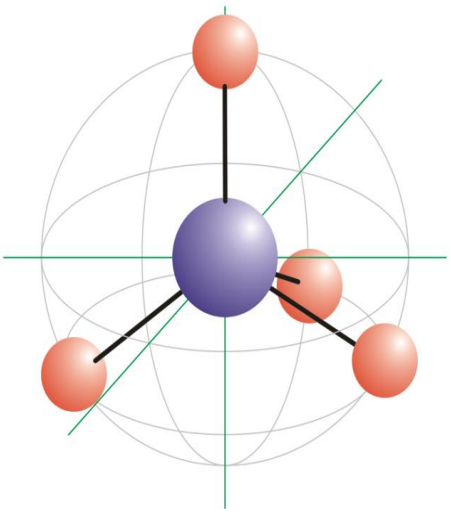


Figure 1.10 Four sp^3 hybrid orbitals, oriented to the corners of a regular tetrahedron, are formed by combination of an *s* orbital and three *p* orbitals (red/blue). The sp^3 hybrids have two lobes and are unsymmetrical about the nucleus, giving them a directionality and allowing them to form strong bonds when they overlap an orbital from another atom.

Bond angle: 109.5^0

Shape: Tetrahedral


z
y
x
HYBRIDISATION



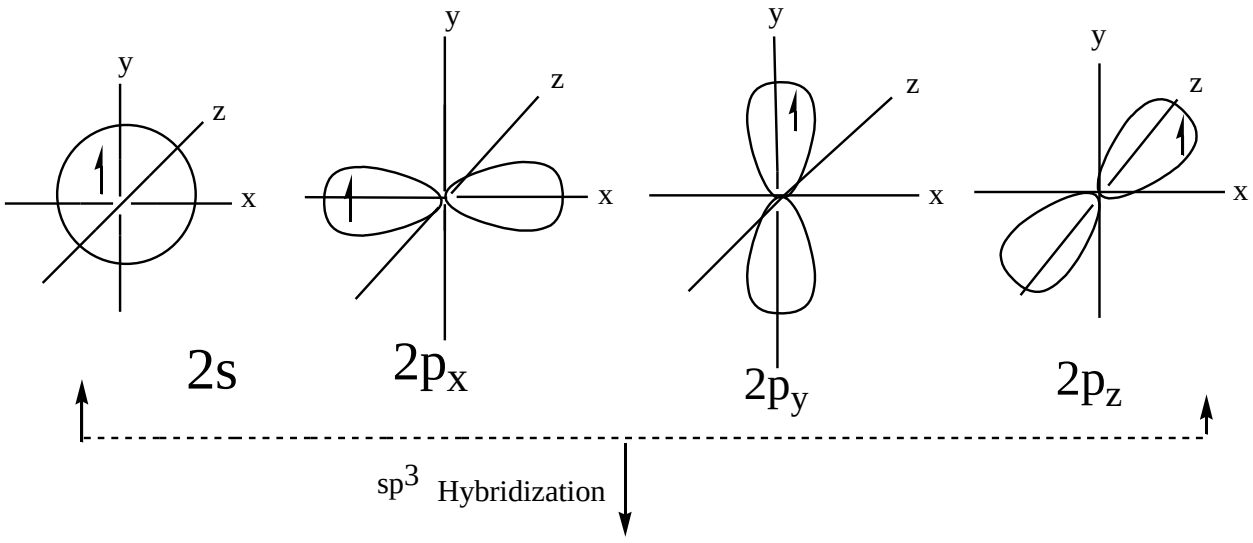
In CH_4 molecule, the central atom is C

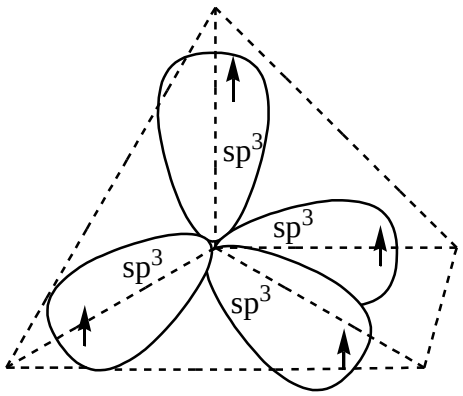
The ground state electron configuration is-$2p_x$

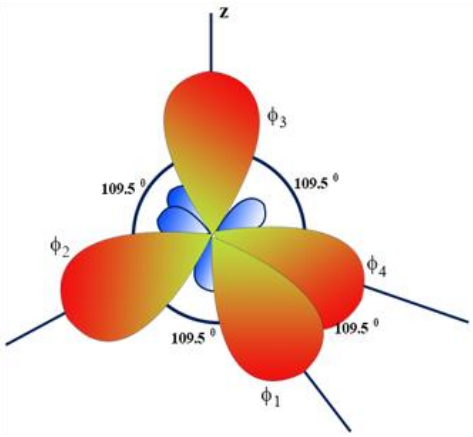
$_6C = 1s^2\ 2s^2\ 2p^2$

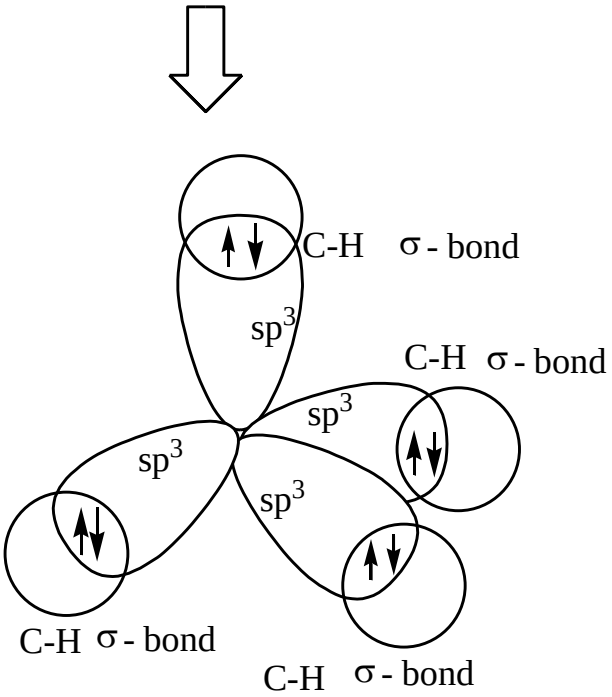
$_6C^* = 1s^2\ 2s^1\ 2p_x^1\ 2p_y^1\ 2p_z^1$ (at excited state)

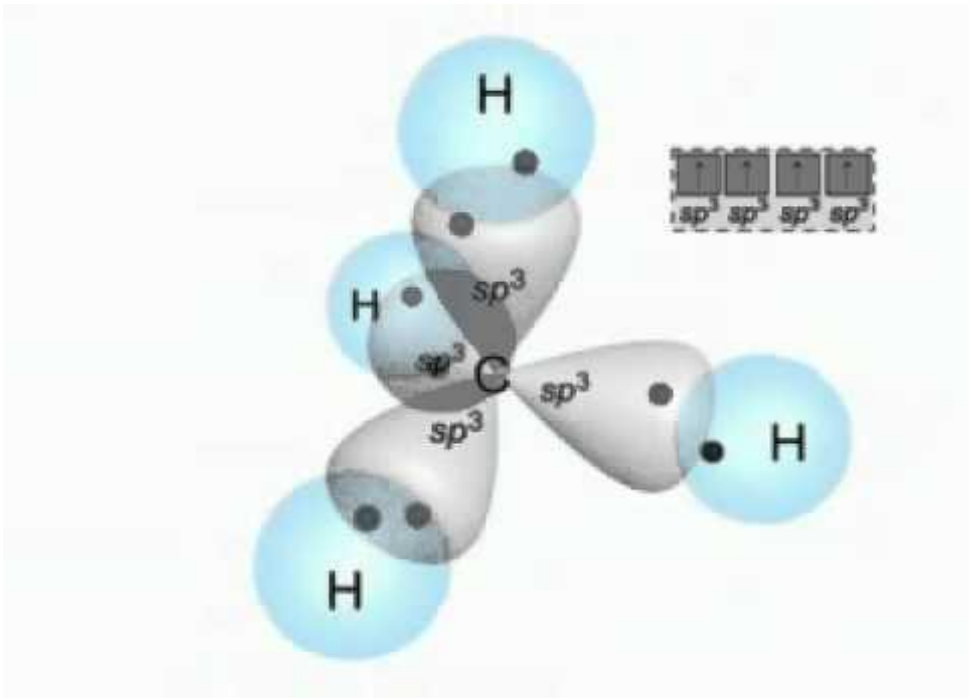
Four sp^3 hybrid orbitals are formed when 2s orbital mixes with three $2p_x$, $2p_y$, $2p_z$ orbitals.

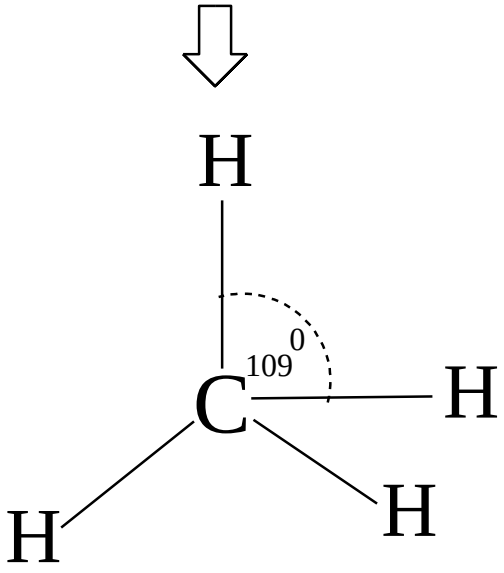







C-H σ - bond
sp3
C-H σ - bond
sp3
sp3
sp3
C-H σ - bond
C-H σ - bond


H
sp3 sp3 sp3 sp3
H
sp3
sp3
C
sp3
sp3
H
H



Tetrahedral shape