Hybridization

Bonds form in the direction of maximum overlap. (L. Pauling)

Mix n AOs to get n hybrids:

Orthonormal set of Atomic Orbitals

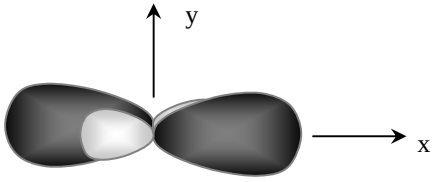
equivalent in extent, shape, and energy

differ in orientation: to maximize overlap

50% p-character

sp $\Psi_a = \frac{1}{\sqrt{2}}(s + p_x)$

$\Psi_b = \frac{1}{\sqrt{2}}(s - p_x)$



$\int \Psi_a^2 \, d\tau = ½ \int s^2 + 2\, sp_x + p_x^2 \, d\tau = 1$

$\int \Psi_a \Psi_b \, d\tau = ½ \int (s + p_x)(s - p_x) \, d\tau = ½ \int s^2 - p_x^2 \, d\tau = 0$

$\int s^2 \, d\tau = \int p_x^2 \, d\tau = 1$ atomic normalization $\int sp_x \, d\tau = 0$ orthogonality

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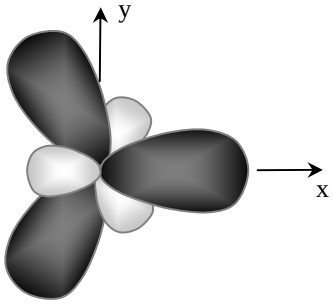
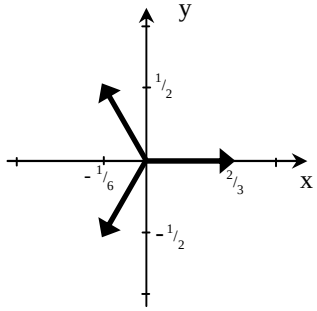
66% p-character

sp^2 $\Psi_a = \frac{1}{\sqrt{3}} s + \frac{\sqrt{2}}{\sqrt{3}} p_x$

$\Psi_b = \frac{1}{\sqrt{3}} s - \frac{1}{\sqrt{6}} p_x + \frac{1}{\sqrt{2}} p_y$

$\Psi_c = \frac{1}{\sqrt{3}} s - \frac{1}{\sqrt{6}} p_x - \frac{1}{\sqrt{2}} p_y$





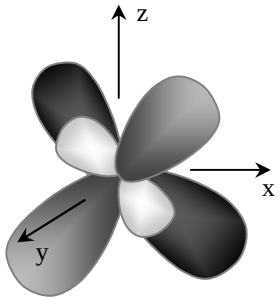
75% p-character

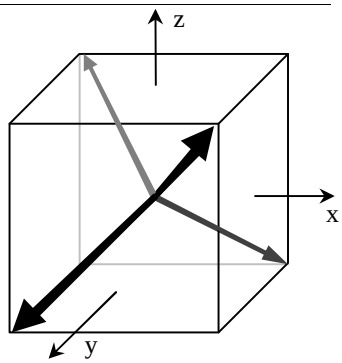
sp^3 $\Psi_a = ½ (s + p_x + p_y + p_z)$

$\Psi_b = ½ (s - p_x + p_y - p_z)$

$\Psi_c = ½ (s + p_x - p_y - p_z)$

$\Psi_d = ½ (s - p_x - p_y + p_z)$





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bond angle:	90°	109.5°	120°	180°
hybridization:	p^3	sp^3	sp^2	sp
examples:	PH_3 (93°)	CH_4 (109.5°)	BF_3 (120°)	BeH_2 (180°)
	H_2S (92°)	NH_3 (107°)	CO_3^{2-} (120°)	HC≡CH
		H_2O (104.5°) O_3 (116.8°)	$:CH_2$ (137.8°)	