

$\vec{S} = \sum \vec{s}_i$
 Sum over valence e^-
 "Multiplicity" $2S+1$

Parity = "e" if $\prod (-1)^{l_i} = +1$
 Parity = "o" if $\prod (-1)^{l_i} = -1$

$\vec{L} = \sum \vec{l}_i$
 $L = 0 \rightarrow S$
 $L = 1 \rightarrow P$
 $L = 2 \rightarrow D$
 $L = 3 \rightarrow F$
 $L = 4 \rightarrow G$
 etc.

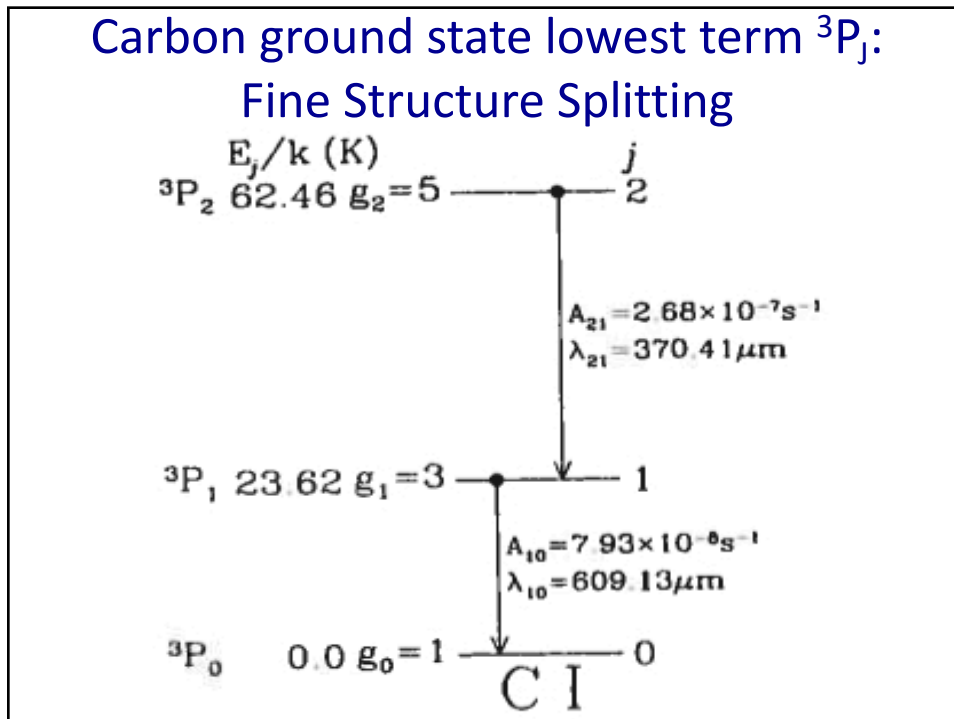
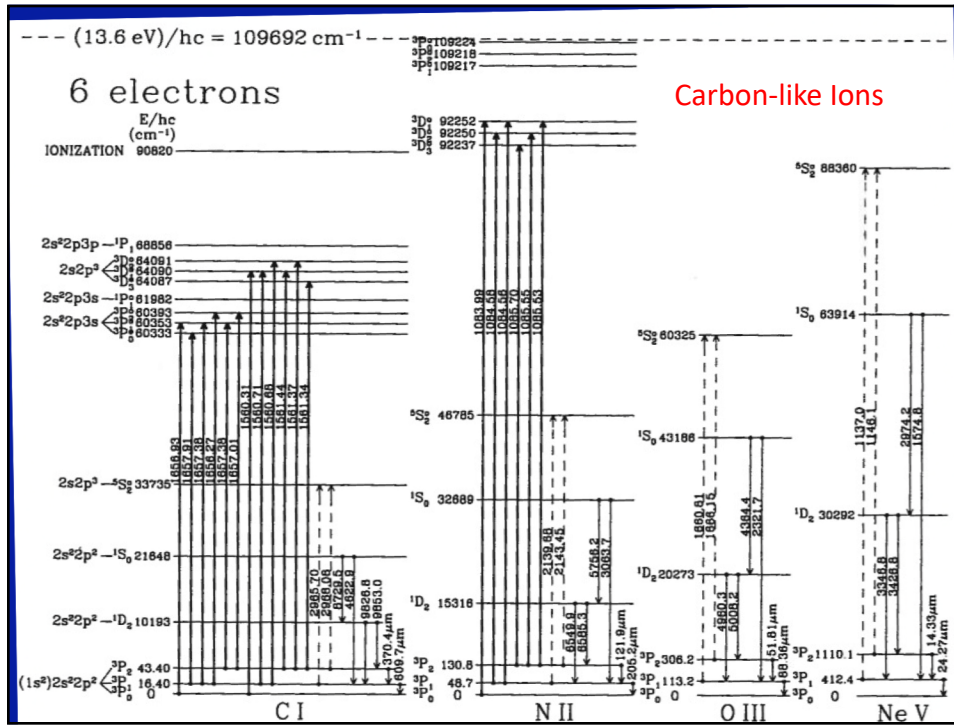
$J = L + S, L + S - 1, \dots |L - S|$

Diagram showing the addition of spin (S) and orbital (L) angular momentum to form total angular momentum (J). The multiplicity $2S+1$ is shown in red, and the parity p is shown in white. The total angular momentum J is shown in green.

TABLE 12.3 States allowed by the exclusion principle in the L-S coupling scheme

ns^0	1S				
ns^1		2S			
ns^2	1S				
np^0	1S				
np^1		2P			
np^2	$^1S, ^1D$		3P		
np^3		$^2P, ^2D$		4S	
np^4	$^1S, ^1D$		3P		
np^5		2P			
np^6	1S				
nd^0	1S				
nd^1		2D			
nd^2	$^1S, ^1D, ^1G$			$^3P, ^3F$	
nd^3		$^2D, ^2P, ^2D, ^2F, ^2G, ^2H$			$^4P, ^4F$
nd^4	$^1S, ^1D, ^1G, ^1S, ^1D, ^1G, ^1F, ^1I$			$^3P, ^3F, ^3P, ^3D, ^3F, ^3G, ^3H$	5D
nd^5		$^2D, ^2P, ^2D, ^2F, ^2G, ^2H, ^2S, ^2D, ^2F, ^2G, ^2I$		$^4P, ^4F, ^4D, ^4G$	6S
nd^6	$^1S, ^1D, ^1G, ^1S, ^1D, ^1G, ^1F, ^1I$			$^3P, ^3F, ^3P, ^3D, ^3F, ^3G, ^3H$	5D
nd^7		$^2D, ^2P, ^2D, ^2F, ^2G, ^2H$			$^4P, ^4F$
nd^8	$^1S, ^1D, ^1G$			$^3P, ^3F$	
nd^9		2D			
nd^{10}	1S				

Highest E ← Lowest E



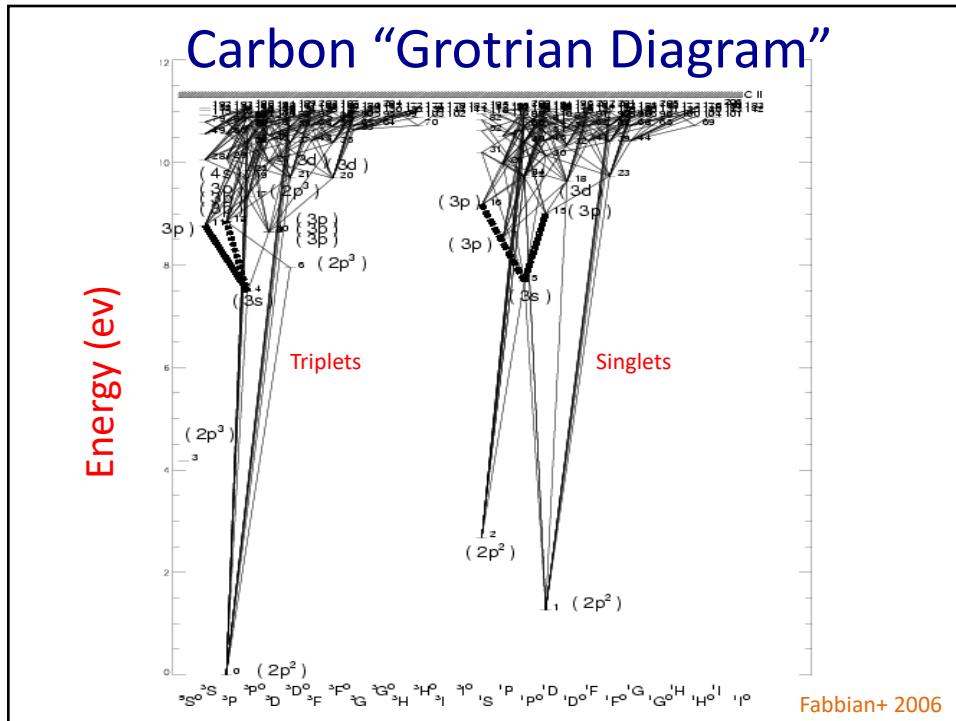


TABLE 12.4 The periodic table

Period ↓	Group →																							
	I	II	Transition elements										III	IV	V	VI	VII	VIII						
1	H ¹ 1s ¹																		He ² 1s ²					
2	Li ³ 1s ² 2s ¹	Be ⁴ 1s ² 2s ²																	B ⁵ 2s ² 2p ¹	C ⁶ 2s ² 2p ²	N ⁷ 2s ² 2p ³	O ⁸ 2s ² 2p ⁴	F ⁹ 2s ² 2p ⁵	Ne ¹⁰ 1s ² 2s ² 2p ⁶
3	Na ¹¹ 3s ¹	Mg ¹² 3s ²																	Al ¹³ 3s ² 3p ¹	Si ¹⁴ 3s ² 3p ²	P ¹⁵ 3s ² 3p ³	S ¹⁶ 3s ² 3p ⁴	Cl ¹⁷ 3s ² 3p ⁵	Ar ¹⁸ 3s ² 3p ⁶
4	K ¹⁹ 4s ¹	Ca ²⁰ 4s ²	Sc ²¹ 4s ² 3d ¹	Ti ²² 4s ² 3d ²	V ²³ 4s ² 3d ³	Cr ²⁴ 4s ¹ 3d ⁵	Mn ²⁵ 4s ² 3d ⁵	Fe ²⁶ 4s ² 3d ⁶	Co ²⁷ 4s ² 3d ⁷	Ni ²⁸ 4s ² 3d ⁸	Cu ²⁹ 4s ¹ 3d ¹⁰	Zn ³⁰ 4s ² 3d ¹⁰	Ga ³¹ 4s ² 3d ¹⁰ 4p ¹	Ge ³² 4s ² 3d ¹⁰ 4p ²	As ³³ 4s ² 3d ¹⁰ 4p ³	Se ³⁴ 4s ² 3d ¹⁰ 4p ⁴	Br ³⁵ 4s ² 3d ¹⁰ 4p ⁵	Kr ³⁶ 4s ² 3d ¹⁰ 4p ⁶						
5	Rb ³⁷ 5s ¹	Sr ³⁸ 5s ²	Y ³⁹ 5s ² 4d ¹	Zr ⁴⁰ 5s ² 4d ²	Nb ⁴¹ 5s ¹ 4d ⁴	Mo ⁴² 5s ¹ 4d ⁵	Tc ⁴³ 5s ² 4d ⁵	Ru ⁴⁴ 5s ¹ 4d ⁷	Rh ⁴⁵ 5s ¹ 4d ⁸	Pd ⁴⁶ 4d ¹⁰	Ag ⁴⁷ 5s ¹ 4d ¹⁰	Cd ⁴⁸ 5s ² 4d ¹⁰	In ⁴⁹ 5s ² 4d ¹⁰ 5p ¹	Sn ⁵⁰ 5s ² 4d ¹⁰ 5p ²	Sb ⁵¹ 5s ² 4d ¹⁰ 5p ³	Te ⁵² 5s ² 4d ¹⁰ 5p ⁴	I ⁵³ 5s ² 4d ¹⁰ 5p ⁵	Xe ⁵⁴ 5s ² 4d ¹⁰ 5p ⁶						
6	Cs ⁵⁵ 6s ¹	Ba ⁵⁶ 6s ²	La ⁵⁷ 6s ² 5d ¹	Hf ⁷² 6s ² 5d ²	Ta ⁷³ 6s ² 5d ³	W ⁷⁴ 6s ² 5d ⁴	Re ⁷⁵ 6s ² 5d ⁵	Os ⁷⁶ 6s ² 5d ⁶	Ir ⁷⁷ 6s ² 5d ⁷	Pt ⁷⁸ 6s ¹ 5d ⁹	Au ⁷⁹ 6s ¹ 5d ¹⁰	Hg ⁸⁰ 6s ² 5d ¹⁰	Tl ⁸¹ 6s ² 5d ¹⁰ 6p ¹	Pb ⁸² 6s ² 5d ¹⁰ 6p ²	Bi ⁸³ 6s ² 5d ¹⁰ 6p ³	Po ⁸⁴ 6s ² 5d ¹⁰ 6p ⁴	At ⁸⁵ 6s ² 5d ¹⁰ 6p ⁵	Rn ⁸⁶ 6s ² 5d ¹⁰ 6p ⁶						
7	Fr ⁸⁷ 7s ¹	Ra ⁸⁸ 7s ²	Ac ⁸⁹ 7s ² 6d ¹																					
Rare earths ^a			Ce ⁵⁸ 6s ² 5d ¹ 4f ¹	Pr ⁵⁹ 6s ² 4f ³	Nd ⁶⁰ 6s ² 4f ⁴	Pm ⁶¹ 6s ² 4f ⁵	Sm ⁶² 6s ² 4f ⁶	Eu ⁶³ 6s ² 4f ⁷	Gd ⁶⁴ 6s ² 5d ¹ 4f ⁷	Tb ⁶⁵ 6s ² 5d ¹ 4f ⁸	Dy ⁶⁶ 6s ² 4f ¹⁰	Ho ⁶⁷ 6s ² 4f ¹¹	Er ⁶⁸ 6s ² 4f ¹²	Tm ⁶⁹ 6s ² 4f ¹³	Yb ⁷⁰ 6s ² 4f ¹⁴	Lu ⁷¹ 6s ² 5d ¹ 4f ¹⁴								
Heavy elements ^b			Th ⁹⁰ 7s ² 6d ²	Pa ⁹¹ 6d ³	U ⁹² 6d ¹ 5f ³	Np ⁹³ 6d ¹ 5f ⁵	Pu ⁹⁴ 6d ¹ 5f ⁶	Am ⁹⁵ 6d ¹ 5f ⁷	Cm ⁹⁶ 6d ¹ 5f ⁷	Bk ⁹⁷ 6d ¹ 5f ⁹	Cf ⁹⁸ 6d ¹ 5f ¹⁰	Es ⁹⁹ 6d ¹ 5f ¹¹	Fm ¹⁰⁰ 6d ¹ 5f ¹²	Md ¹⁰¹ 6d ¹ 5f ¹³										

^a With La⁵⁷ included, this group is also called the *lanthanides*.
^b With Ac⁸⁹ included, this group is also called the *actinides*.