Vorlesung Allgemeine Chemie für DBHS
Chemie für LA Biologie
WS 2022/23

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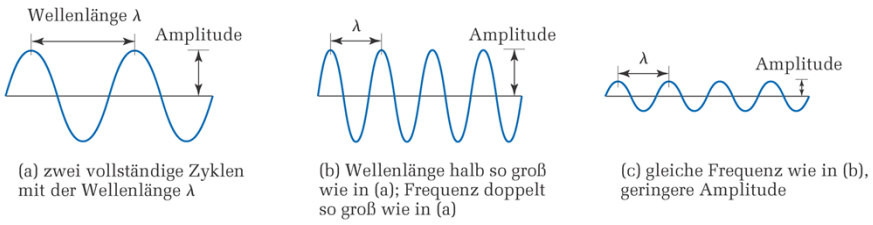
- Webseite zur Vorlesung (Folien, Übungsblätter):
- http://www.chemie.uni-siegen.de/pc/lehre/dbhs/

Zugangsdaten:

User: Ludwig

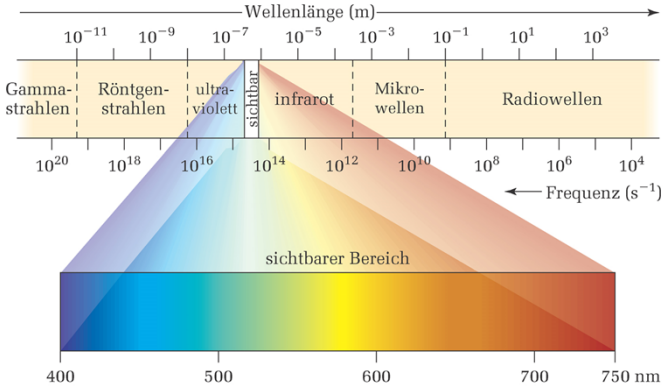
Passwort: Boltzmann



(a) zwei vollständige Zyklen mit der Wellenlänge λ

(b) Wellenlänge halb so groß wie in (a); Frequenz doppelt so groß wie in (a)

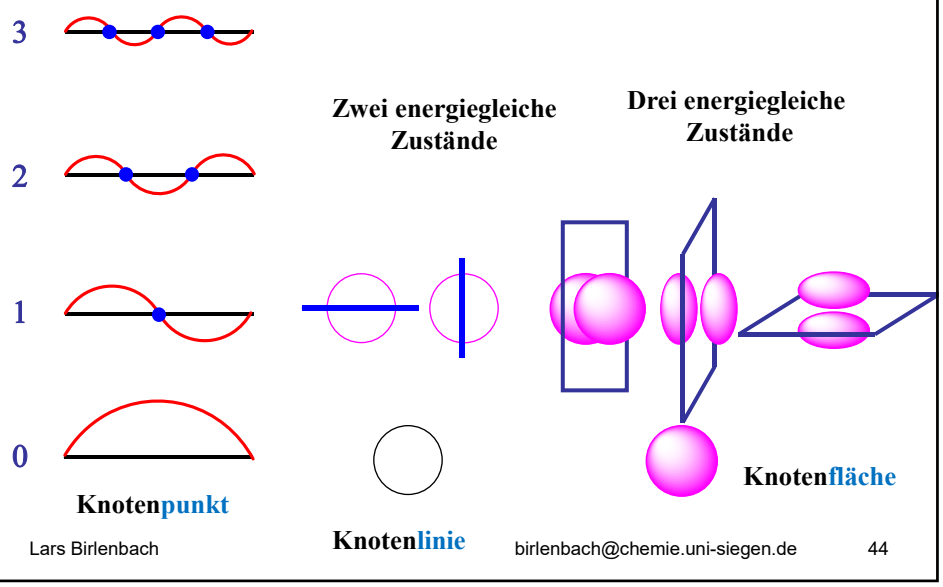
(c) gleiche Frequenz wie in (b), geringere Amplitude



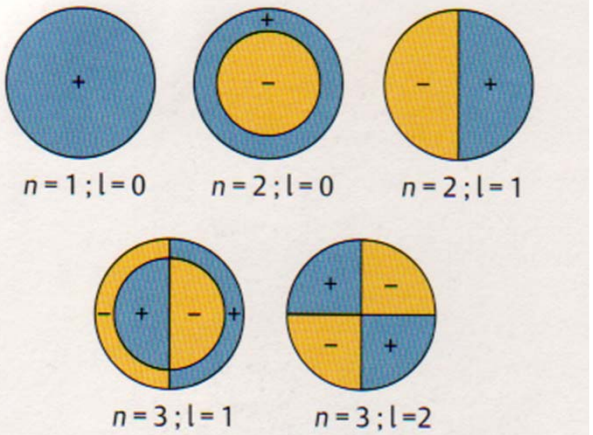
$$\lambda \cdot \nu = c$$

$$E = h \cdot \nu = h \cdot \frac{c}{\lambda}$$

Stehende Wellen

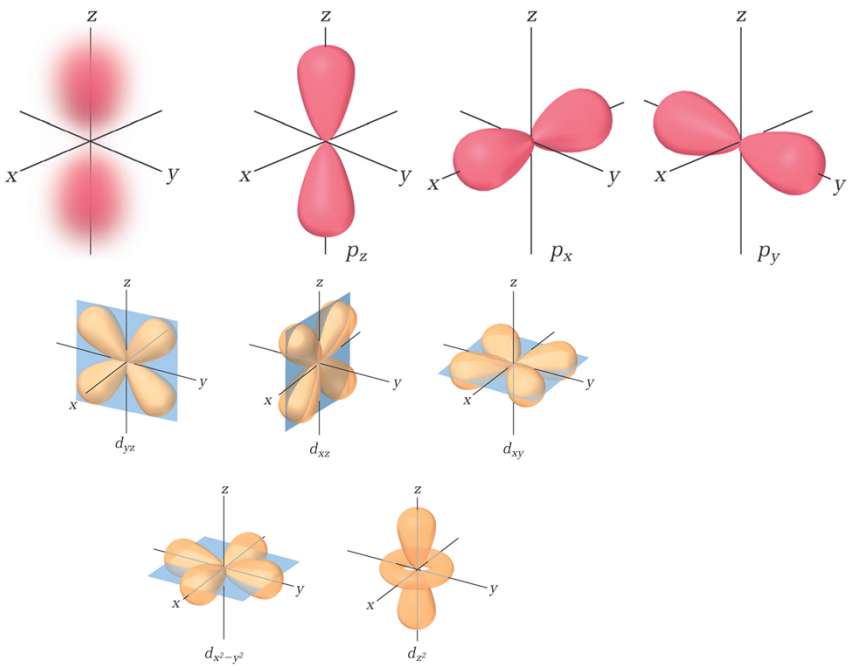


Zweidimensionale stehende Wellen



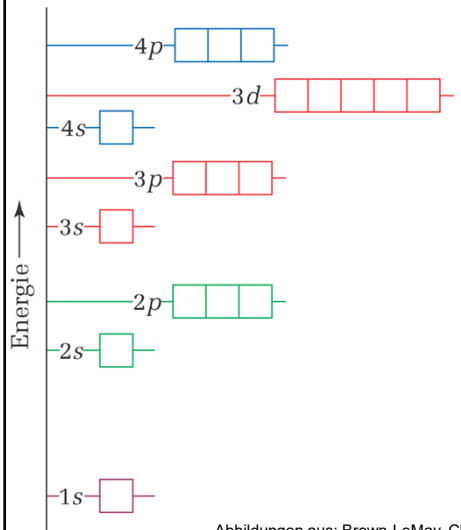
6.11 Einige stehende Wellen eines Paukenfells. Die momentane Auslenkung des Fells über bzw. unter die Ebene ist mit + und − bezeichnet.

aus:: Mortimer, Chemie, 10. Auflage Thieme Verlag



Abbildungen aus: Brown-LeMay, Chemie
siehe www.pearson-studium.de

Energieniveaus der Orbitale



Abbildungen aus: Brown-LeMay, Chemie
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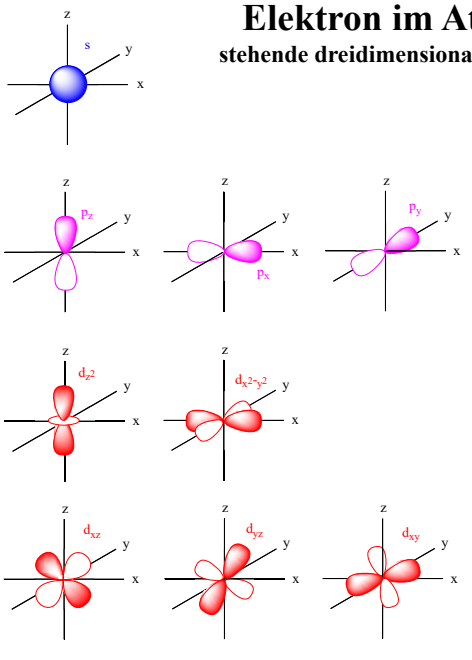
Elektron im Atom

stehende dreidimensionale Welle

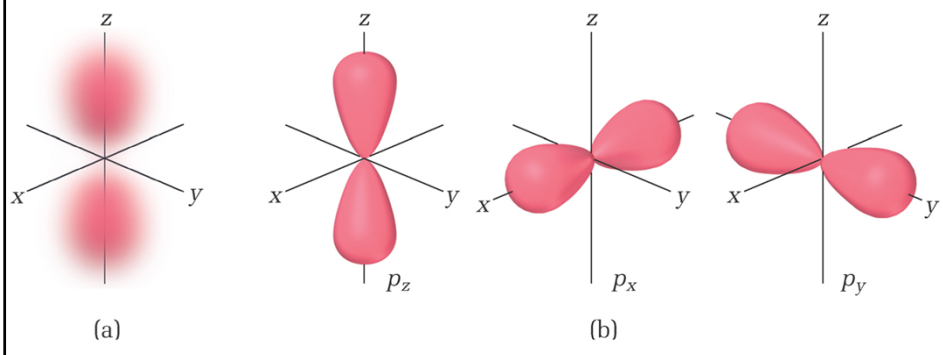


0 Knotenebenen
s-Orbitale

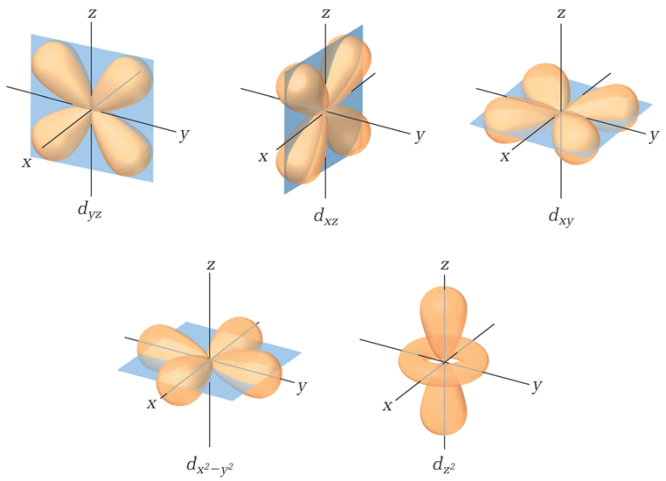
1 Knotenebene
p-Orbitale

2 Knotenebenen
d-Orbitale

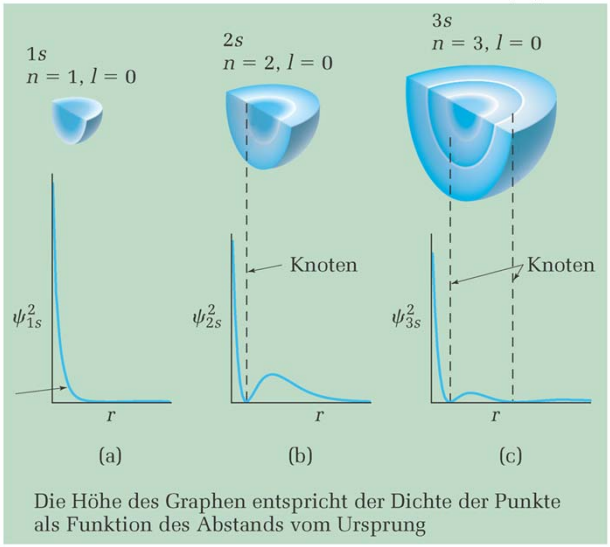
Die p-Orbitale



Die d-Orbitale

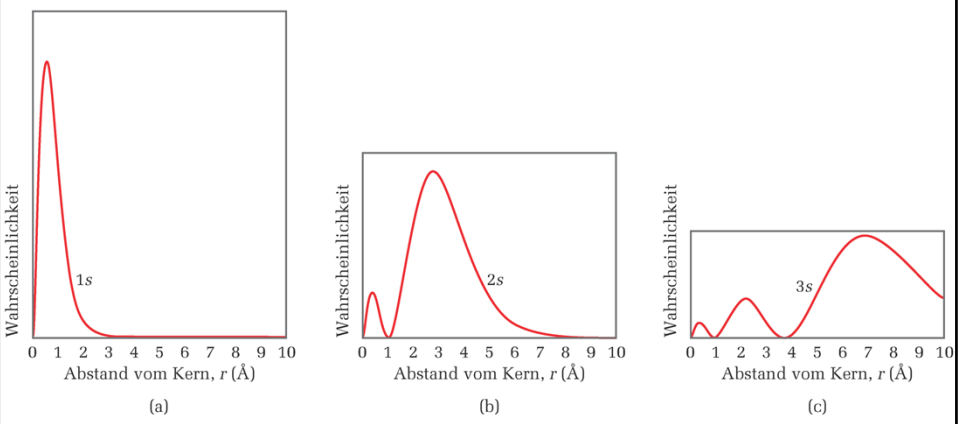


Wellenfunktion Ψ^2 als f(r)



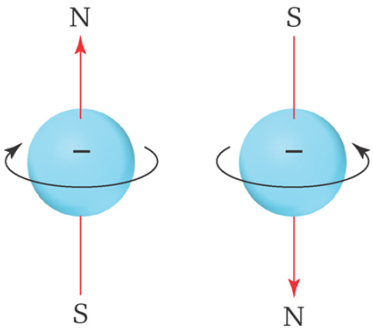
Die Höhe des Graphen entspricht der Dichte der Punkte als Funktion des Abstands vom Ursprung

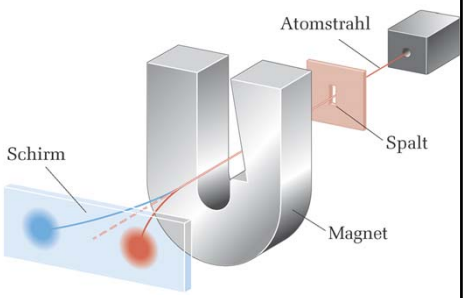
Aufenthaltswahrscheinlichkeiten der Elektronen in s-Orbitalen



$$\text{Wahrscheinlichkeit} \propto 4\pi r^2 \Psi^2$$

Elektronenspin





Abbildungen aus: Brown-LeMay, Chemie
siehe www.pearson-studium.de

Quantenzahlen

- Hauptquantenzahl n: Größe der Wellenfunktion
  - n = 1,2, ...
- Nebenquantenzahl l: Anzahl der Knotenebenen (Form der Wellenfunktion)
  - l = 0, keine Knotenebene, Kugelsymmetrie, s-Orbitale
  - l = 1, eine Knotenebene, p-Orbitale
  - l = 2, zwei Knotenebenen, d-Orbitale
  - l = 0, 1, 2,... n-1
- Magnetquantenzahl m: Ausrichtung der Wellenfunktion im Raum
  - m = -l, ... , 0, ... , +l
- Spinquantenzahl s: „Drehimpuls“ des Elektrons
  - +½ , -½

Pauli-Prinzip: in einem Atom müssen sich alle Elektronen in mindestens einer QZ unterscheiden.

Tabelle 6.3

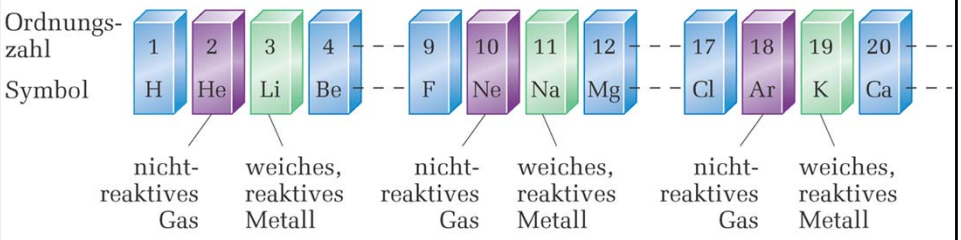
Elektronenkonfiguration einiger leichter Elemente

Element	Gesamtzahl Elektronen	Orbitaldiagramm 1s	2s	2p	3s	Elektronenkonfiguration
Li	3	↿⇂	↿			$1s^2 2s^1$
Be	4	↿⇂	↿⇂			$1s^2 2s^2$
B	5	↿⇂	↿⇂	↿		$1s^2 2s^2 2p^1$
C	6	↿⇂	↿⇂	↿ ↿		$1s^2 2s^2 2p^2$
N	7	↿⇂	↿⇂	↿ ↿ ↿		$1s^2 2s^2 2p^3$
Ne	10	↿⇂	↿⇂	↿⇂ ↿⇂ ↿⇂		$1s^2 2s^2 2p^6$
Na	11	↿⇂	↿⇂	↿⇂ ↿⇂ ↿⇂	↿	$1s^2 2s^2 2p^6 3s^1$

Elektronenkonfiguration für Chlor (OZ 17)

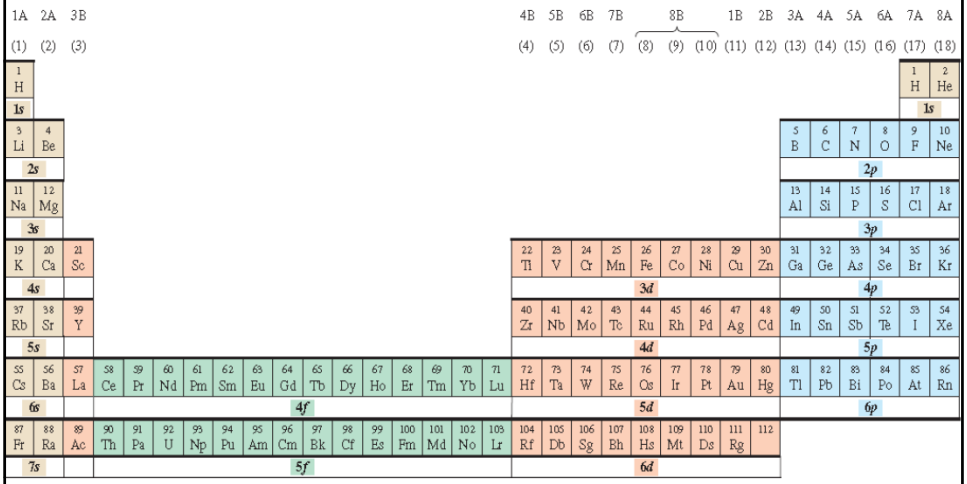
Electron	n	ℓ	m_ℓ	m_s	e^- Configuration
1, 2	1	0	0	$\pm\frac{1}{2}$	$1s^2$
3, 4	2	0	0	$\pm\frac{1}{2}$	$2s^2$
5–10	2	1	−1	$\pm\frac{1}{2}$	$2p^6$
	2	1	0	$\pm\frac{1}{2}$	
	2	1	+1	$\pm\frac{1}{2}$	
11, 12	3	0	0	$\pm\frac{1}{2}$	$3s^2$
13–17	3	1	−1	$\pm\frac{1}{2}$	$3p^5$
	3	1	0	$\pm\frac{1}{2}$	
	3	1	+1	$+\frac{1}{2}$ or $-\frac{1}{2}\star$	

Entdeckung des Periodensystems: Wiederkehrende Muster



Abbildungen aus: Brown-LeMay, Chemie
siehe www.pearson-studium.de

PSE und Orbitale



PSE und chemische Eigenschaften

Metalle
Metalloide
Nichtmetalle

	1A 1	2A 2	3B 3	4B 4	5B 5	6B 6	7B 7	8B 8	8B 9	8B 10	1B 11	2B 12	3A 13	4A 14	5A 15	6A 16	7A 17	8A 18
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112	113	114	115	116		

Lanthanoide	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
Actinoide	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

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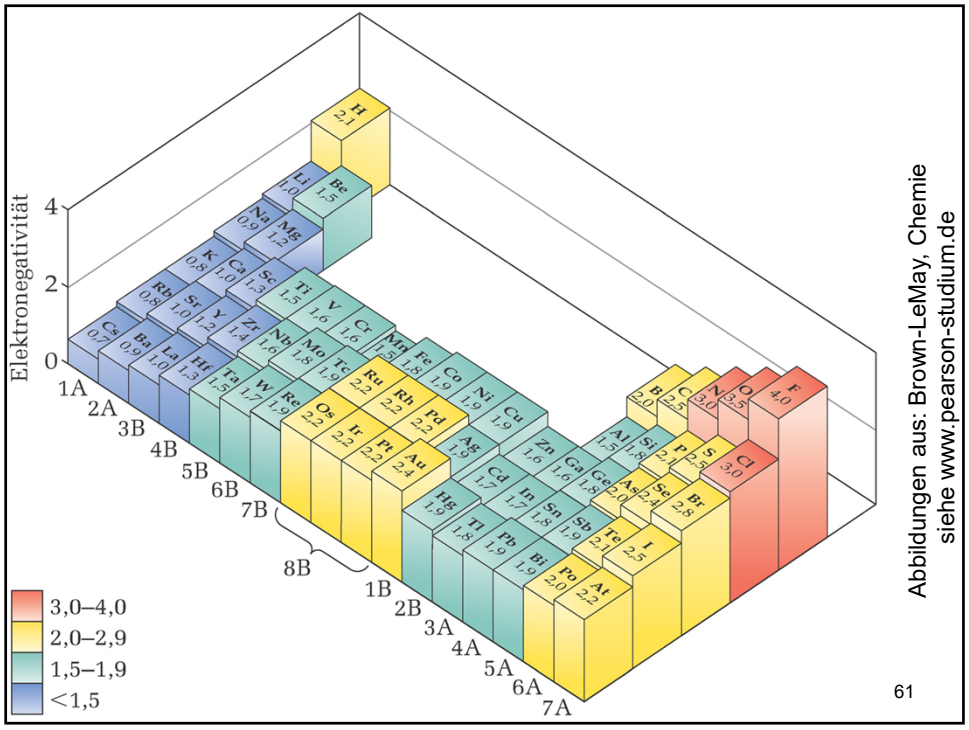

Abbildungen aus: Brown-LeMay, Chemie
siehe www.pearson-studium.de

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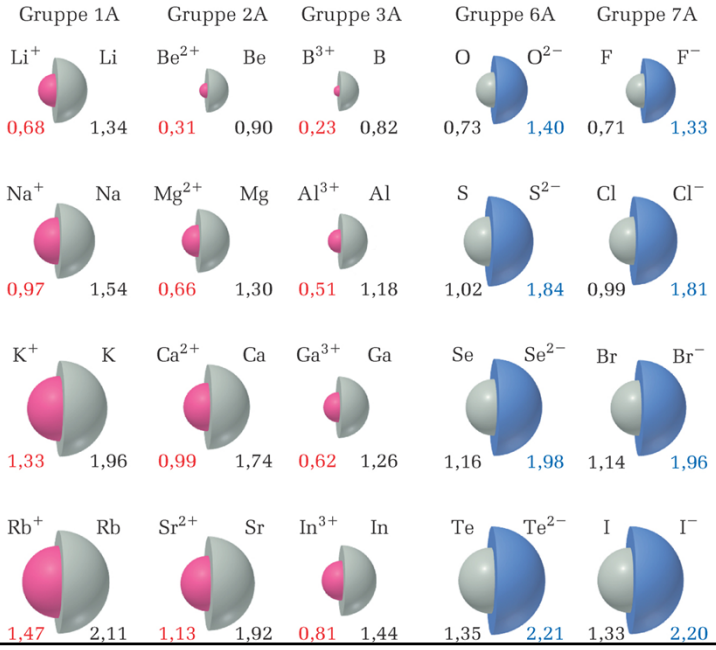
Größe von Atomen und Ionen in Å



Abbildungen aus: Brown-LeMay, Chemie
siehe www.pearson-studium.de

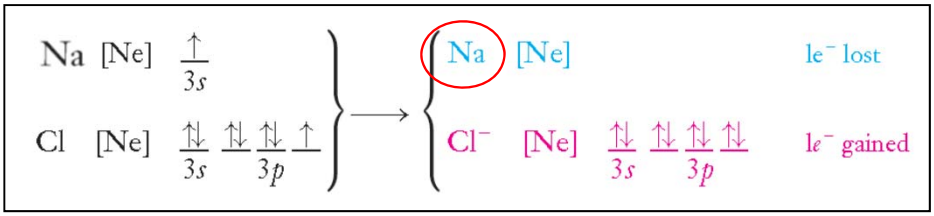
Die chemische Bindung

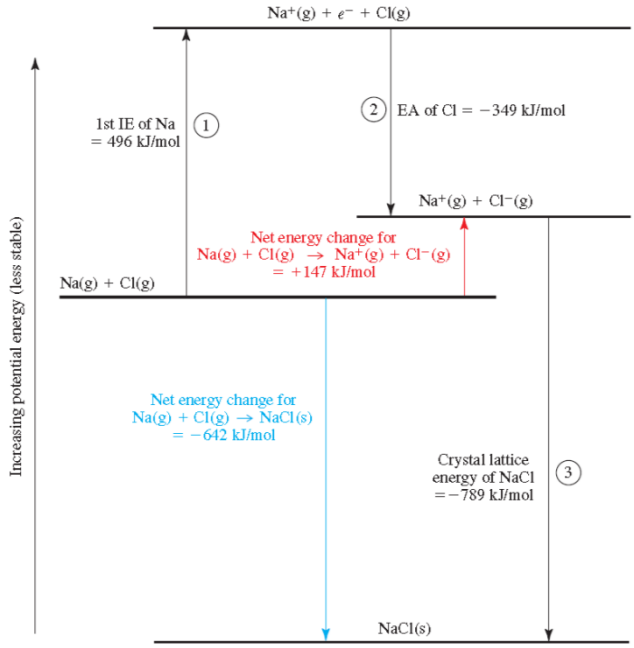
- ionische Bindung
- metallische Bindung
- kovalente Bindung (Moleküle)

Valenzelektronen (Darstellung nach Lewis)

Group	1A	2A	3A	4A	5A	6A	7A	8A
Number of electrons in valence shell	1	2	3	4	5	6	7	8 *(except He)*
Period 1	H·							He:
Period 2	Li·	Be:	·B·	·C·	·N·	·O:	·F:	:Ne:
Period 3	Na·	Mg:	·Al·	·Si·	·P·	·S:	·Cl:	:Ar:
Period 4	K·	Ca:	·Ga·	·Ge·	·As·	·Se:	·Br:	:Kr:
Period 5	Rb·	Sr:	·In·	·Sn·	·Sb·	·Te:	·I:	:Xe:
Period 6	Cs·	Ba:	·Tl·	·Pb·	·Bi·	·Po:	·At:	:Rn:
Period 7	Fr·	Ra:						

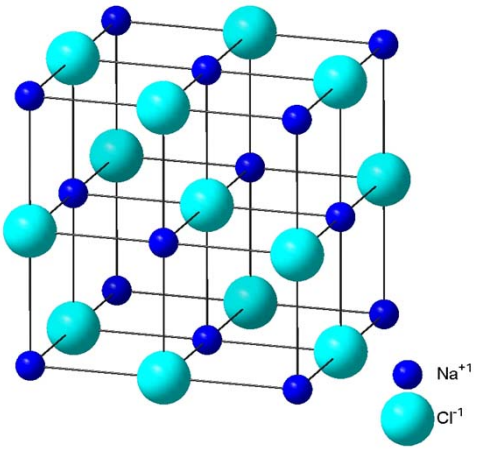
$Na + Cl \rightarrow NaCl$



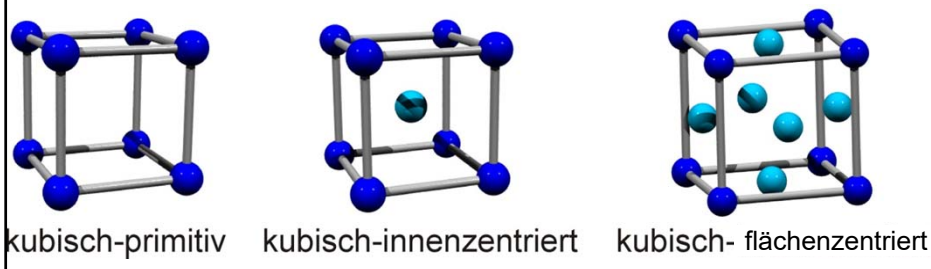


•aus:**Chemistry, 9th Edition** KW Whitten,
•RE Davis, ML Peck, GG Stanley

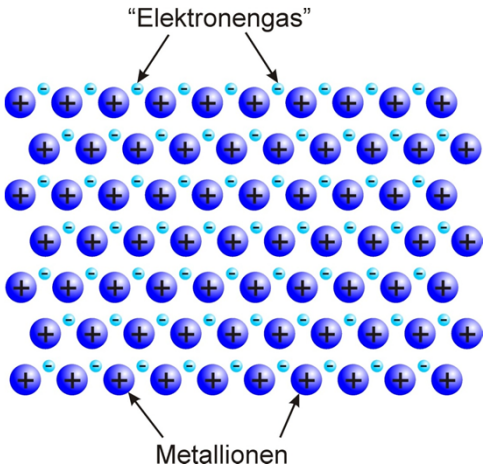
Ionische Bindung



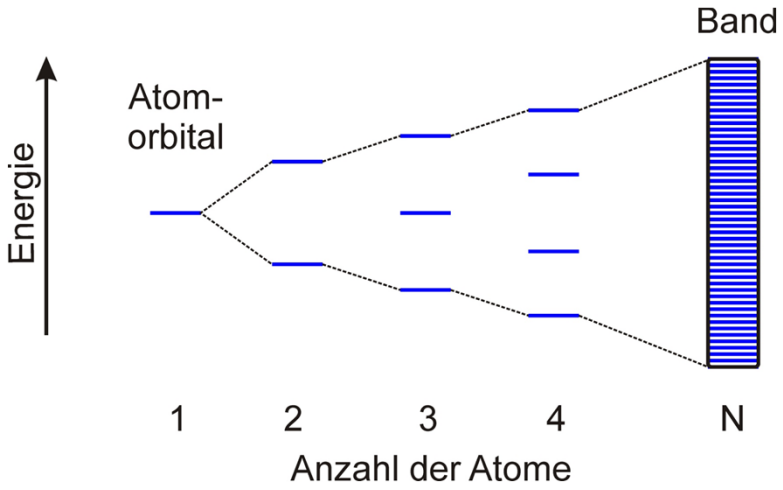
Die 3 Elementarzellen im kubischen Gitter



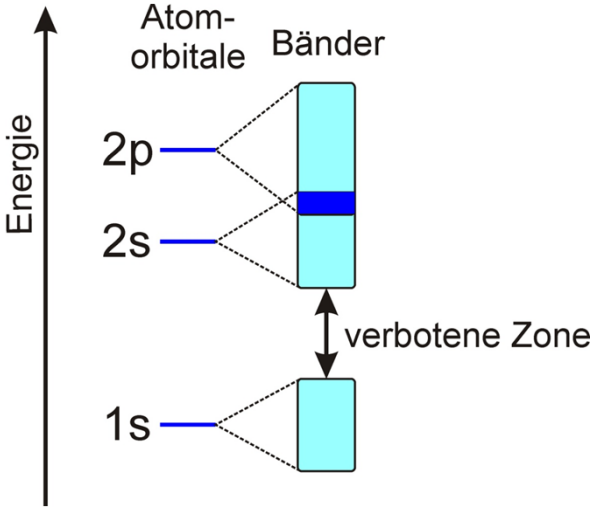
Die chemische Bindung: metallische Bindung



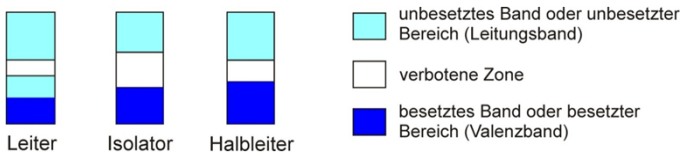
Zusammensetzung eines Bandes im Bändermodell aus den Orbitalen der Atome



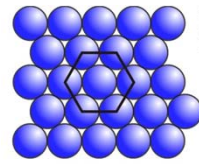
Anwendung des Bändermodells auf Lithiummetall



Unterscheidung zwischen Leiter, Isolator und Halbleiter auf Basis des Bändermodells

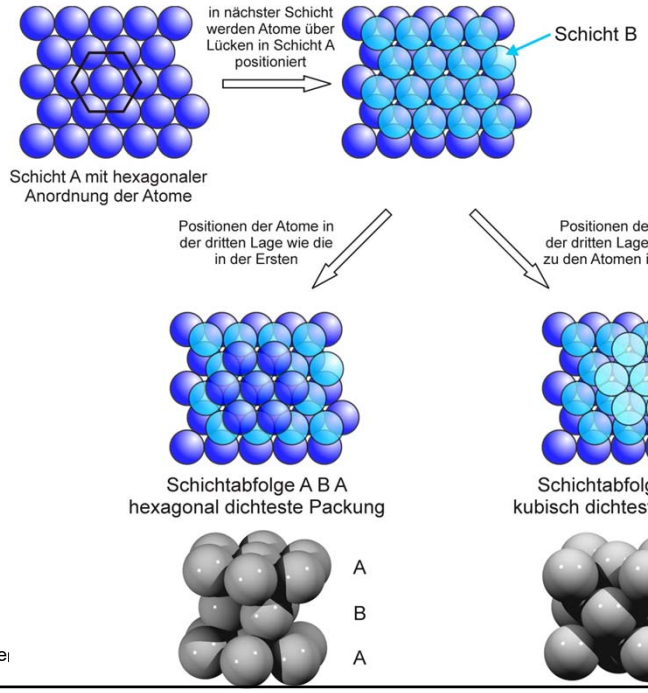


Dichteste Kugelpackungen



Schicht A mit hexagonaler Anordnung der Atome

Dichteste Kugelpackungen

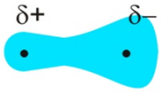


Ionenbindung

Kation Anion

verzerrte Ionenbindung

polarisierte kovalente Bindung



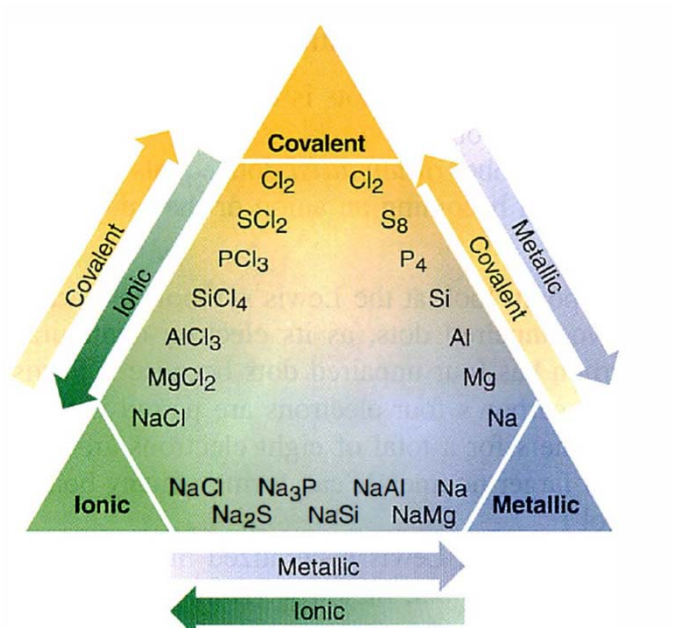
Atom 1 Atom 2

EN Atom 1 < Atom 2

unpolare kovalente Bindung

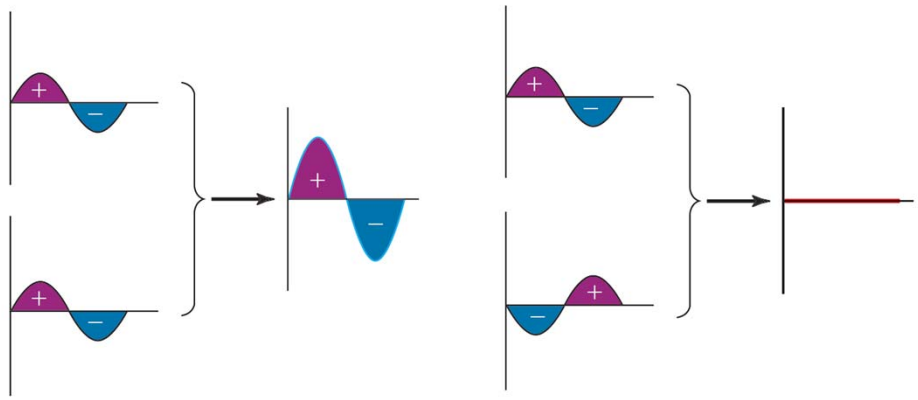
Atom 1 Atom 2

EN Atom 1 ≈ Atom 2



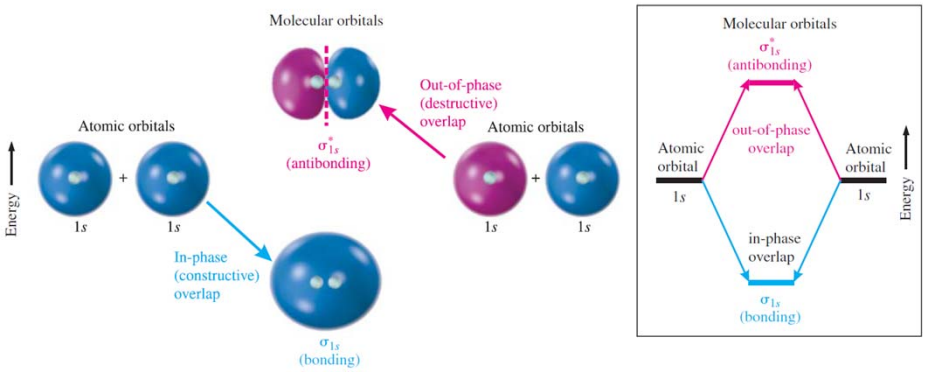
Die kovalente Bindung

Überlagerung von Wellenfunktionen

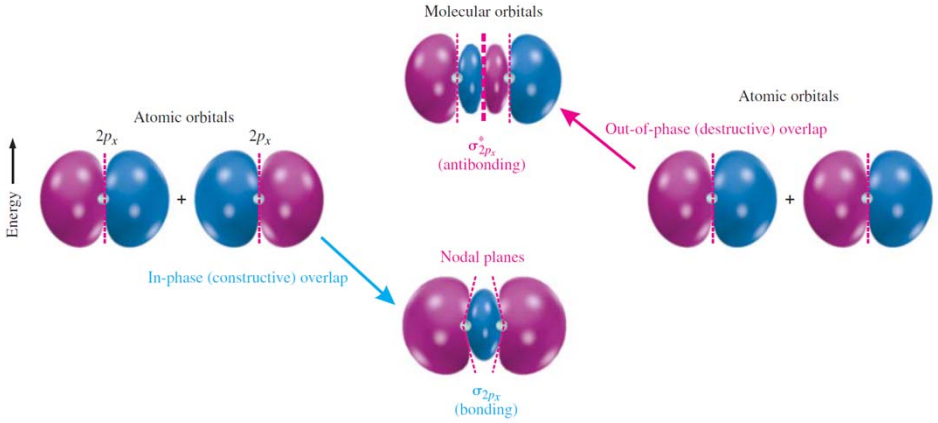


(a) In-phase (constructive) overlap (b) Out-of-phase (destructive) overlap

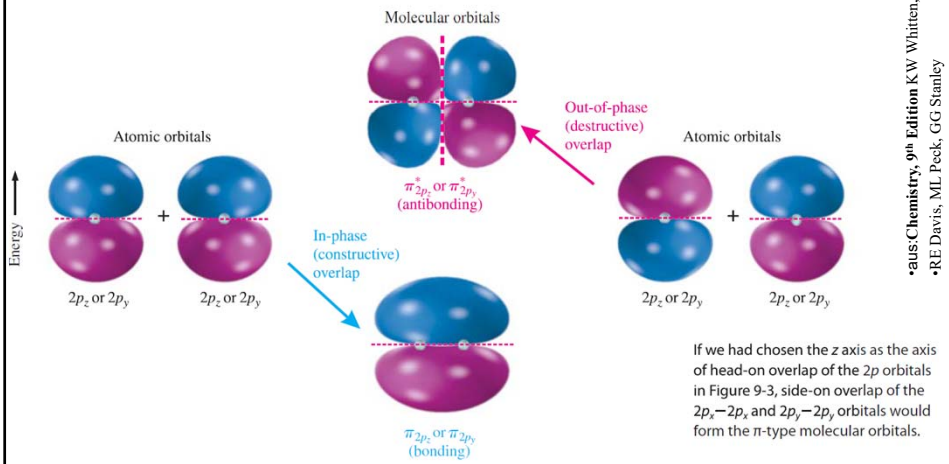
σ-1s-Molekülorbitale



σ-2p-Molekülorbitale

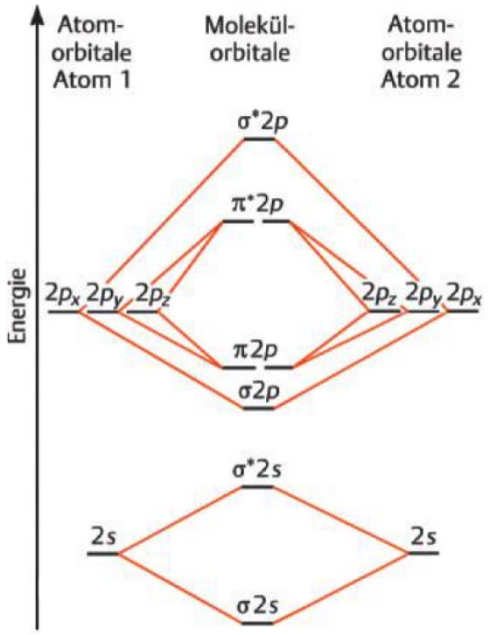


Π-2p-Molekülorbitale



If we had chosen the *z* axis as the axis of head-on overlap of the 2*p* orbitals in Figure 9-3, side-on overlap of the $2p_x$–$2p_x$ and $2p_y$–$2p_y$ orbitals would form the π-type molecular orbitals.

•aus:**Chemistry, 9th Edition** KW Whitten, •RE Davis, ML Peck, GG Stanley



•Chemie
•Das Basiswissen der Chemie
•Charles E. Mortimer
•Ulrich Müller

	H_2	He_2[c]	Li_2[b]	Be_2[c]	B_2[b]	C_2[b]	N_2	O_2	F_2	Ne_2[c]
Increasing energy (not to scale) ↑										
σ^*_{2p}	—	—	—	—	—	—	—	—	—	↑↓
$\pi^*_{2p_y}, \pi^*_{2p_z}$	— —	— —	— —	— —	— —	— —	— —	↑ ↑	↑↓ ↑↓	↑↓ ↑↓
σ_{2p}	—	—	—	—	—	—	↑↓	↑↓	↑↓	↑↓
π_{2p_y}, π_{2p_z}	— —	— —	— —	— —	↑ ↑	↑↓ ↑↓	↑↓ ↑↓	↑↓ ↑↓	↑↓ ↑↓	↑↓ ↑↓
σ^*_{2s}	—	—	—	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓
σ_{2s}	—	—	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓
σ^*_{1s}	—	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓
σ_{1s}	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓	↑↓
Paramagnetic?	no	no	no	no	yes	no	no	yes	no	no
Bond order	1	0	1	0	1	2	3	2	1	0
Observed bond length (Å)	0.74	—	2.67	—	1.59	1.31	1.09	1.21	1.43	—
Observed bond energy (kJ/mol)	436	—	110	9	≈ 270	602	945	498	155	—

[a] Electron distribution in molecular orbitals, bond order, bond length, and bond energy of homonuclear diatomic molecules of the first- and second-period elements. Note that nitrogen molecules, N_2, have the highest bond energies listed; they have a bond order of three. The species C_2 and O_2, with a bond order of two, have the next highest bond energies.
[b] Exists only in the vapor state at elevated temperatures.
[c] Unknown species.

kovalente Bindung