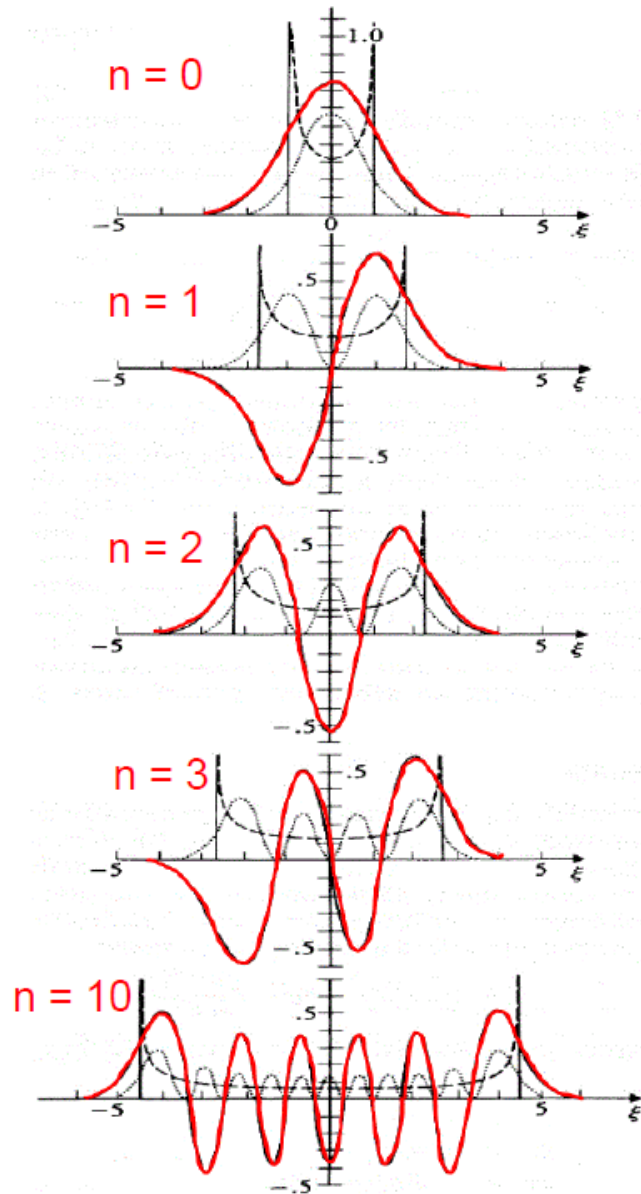


Der eindimensionale harmonische Oszillator



— Wellenfunktion

..... $|\psi|^2$

--- Aufenthaltswahrscheinlichkeit für klassischen Oszillator

Wahrscheinlichkeitsdichte für große Quantenzahlen $n \rightarrow$
Klassische Aufenthaltswahrscheinlichkeit!
(Bohrsches Korrespondenzprinzip)

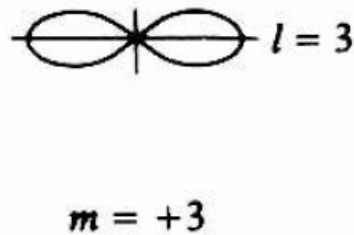
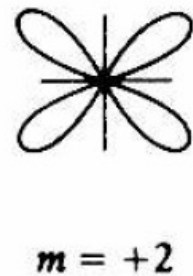
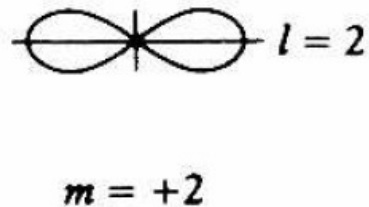
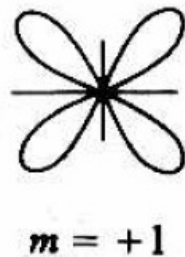
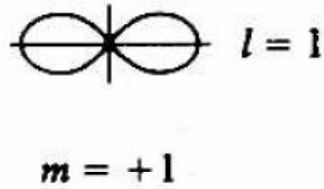
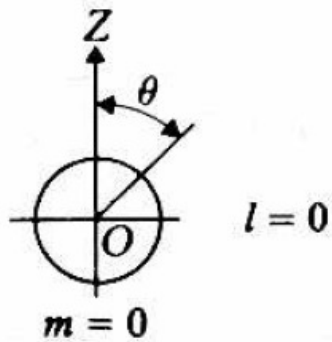
Kugelflächenfunktionen

l	m	
0	0	$Y_{0,0} = \frac{1}{(4\pi)^{1/2}}$
1	0	$Y_{1,0} = \left(\frac{3}{4\pi}\right)^{1/2} \cos \theta$
	± 1	$Y_{1,\pm 1} = \mp \left(\frac{3}{8\pi}\right)^{1/2} \sin \theta e^{\pm i\phi}$
2	0	$Y_{2,0} = \left(\frac{5}{16\pi}\right)^{1/2} (3 \cos^2 \theta - 1)$
	± 1	$Y_{2,\pm 1} = \mp \left(\frac{15}{8\pi}\right)^{1/2} \sin \theta \cos \theta e^{\pm i\phi}$
	± 2	$Y_{2,\pm 2} = \left(\frac{15}{32\pi}\right)^{1/2} \sin^2 \theta e^{\pm 2i\phi}$
3	0	$Y_{3,0} = \left(\frac{7}{16\pi}\right)^{1/2} (5 \cos^3 \theta - 3 \cos \theta)$
	± 1	$Y_{3,\pm 1} = \mp \left(\frac{21}{64\pi}\right)^{1/2} \sin \theta (5 \cos^2 \theta - 1) e^{\pm i\phi}$
	± 2	$Y_{3,\pm 2} = \left(\frac{105}{32\pi}\right)^{1/2} \sin^2 \theta \cos \theta e^{\pm 2i\phi}$
	± 3	$Y_{3,\pm 3} = \mp \left(\frac{35}{64\pi}\right)^{1/2} \sin^3 \theta e^{\pm 3i\phi}$

Polarplots des
Betragsquadrats $|Y_{lm}(\theta, \phi)|^2$
der Kugelflächenfunktionen
[aus: Bransden/Joachain]

Rotationssymmetrie um z-Achse!
Quasiklassische Vorstellung:
Drehimpuls präzediert um Quanti-
sierungsachse z

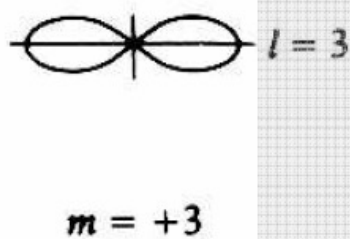
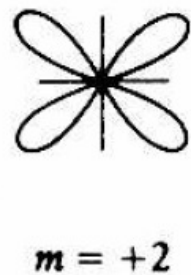
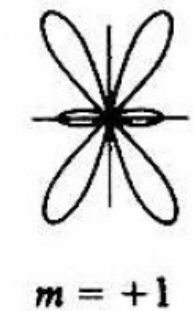
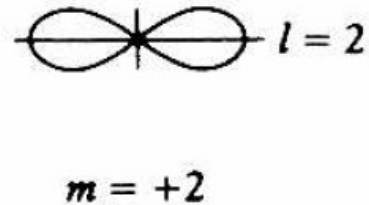
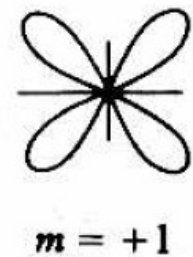
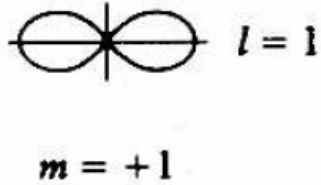
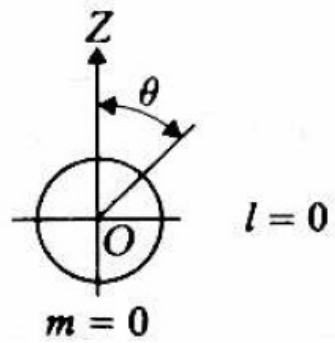
Kugelflächenfunktionen



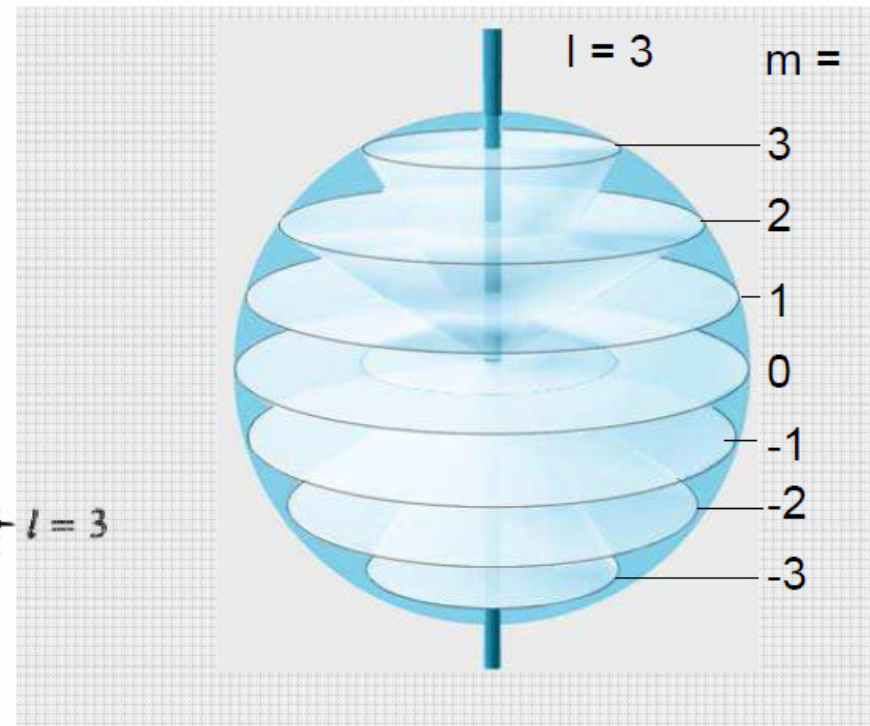
Polarplots des
Betragsquadrats $|Y_{lm}(\theta, \phi)|^2$
der Kugelflächenfunktionen
[aus: Bransden/Joachain]

Rotationssymmetrie um z-Achse!
Quasiklassische Vorstellung:
Drehimpuls präzediert um Quanti-
sierungsachse z

Kugelflächenfunktionen



Polarplots des Betragsquadrats $|Y_{lm}(\theta, \phi)|^2$ der Kugelflächenfunktionen [aus: Bransden/Joachain]



Reelle Darstellung der Kugelflächenfunktionen

$$Y_{l,\cos} = \frac{1}{\sqrt{2}} (Y_{l|m|} + Y_{l|m|}^*)$$

$$Y_{l,\sin} = -\frac{i}{\sqrt{2}} (Y_{l|m|} - Y_{l|m|}^*)$$

$$Y_{l,\cos}(\theta, \phi) = N \Theta_{l|m|}(\theta) \cos|m|\phi$$

$$Y_{l,\sin}(\theta, \phi) = N \Theta_{l|m|}(\theta) \sin|m|\phi$$

Normierungskonstante

Keine Eigenfunktion von L_z !
Nicht rotationssymmetrisch um z-Achse!

l	$ m $	Spherical harmonic in real form
0	0	$s = \frac{1}{(4\pi)^{1/2}}$
1	0	$p_z = \left(\frac{3}{4\pi}\right)^{1/2} \cos \theta$
	1	$p_x = \left(\frac{3}{4\pi}\right)^{1/2} \sin \theta \cos \phi$ $p_y = \left(\frac{3}{4\pi}\right)^{1/2} \sin \theta \sin \phi$
2	0	$d_{3z^2-r^2} = \left(\frac{5}{16\pi}\right)^{1/2} (3 \cos^2 \theta - 1)$
	1	$d_{xz} = \left(\frac{15}{4\pi}\right)^{1/2} \sin \theta \cos \theta \cos \phi$ $d_{yz} = \left(\frac{15}{4\pi}\right)^{1/2} \sin \theta \cos \theta \sin \phi$
	2	$d_{x^2-y^2} = \left(\frac{15}{4\pi}\right)^{1/2} \sin^2 \theta \cos 2\phi$ $d_{xy} = \left(\frac{15}{4\pi}\right)^{1/2} \sin^2 \theta \sin 2\phi$

Reelle Darstellung der Kugelflächenfunktionen

$$Y_{l,\cos} = \frac{1}{\sqrt{2}} (Y_{l|m|} + Y_{l|m|}^*)$$

$$Y_{l,\sin} = -\frac{i}{\sqrt{2}} (Y_{l|m|} - Y_{l|m|}^*)$$

$$Y_{l,\cos}(\theta, \phi) = N \Theta_{l|m|}(\theta) \cos|m|\phi$$

$$Y_{l,\sin}(\theta, \phi) = N \Theta_{l|m|}(\theta) \sin|m|\phi$$

Normierungskonstante

Keine Eigenfunktion von L_z !
Nicht rotationssymmetrisch um z-Achse!

Sinnvoll zur Beschreibung chemischer Bindungen in 3D!

