

Regeln zu Ableitung von Mikrozuständen und Termsymbolen

Einelektronen-Fall: Quantenzahlen (QZ)

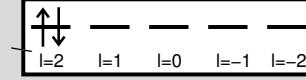
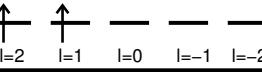
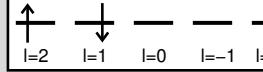
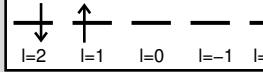
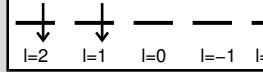
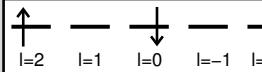
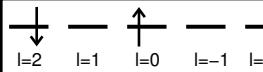
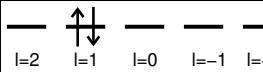
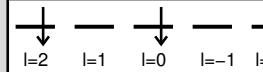
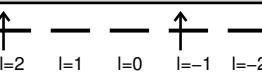
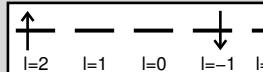
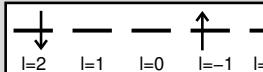
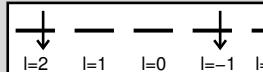
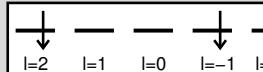
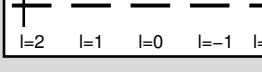
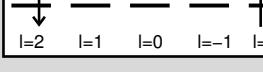
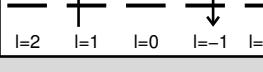
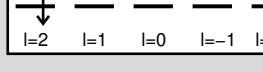
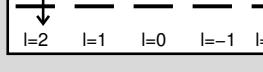
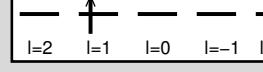
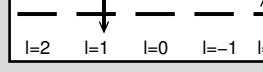
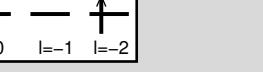
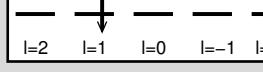
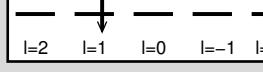
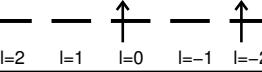
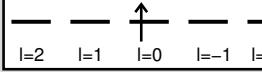
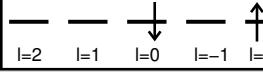
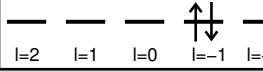
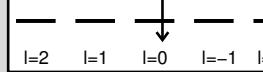
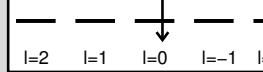
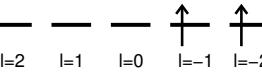
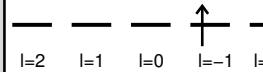
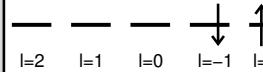
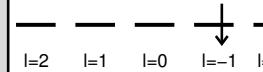
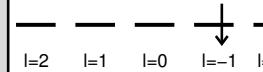
Drehimpuls (QZ: d)				
Quantelung	Bahn-	Eigen-	Gesamt-	
Betrag	$ \tilde{l} = \sqrt{l(l+1)} \frac{h}{2\pi}$ mit $l = 0, \dots, (n-1)$	$ \tilde{s} = \sqrt{s(s+1)} \frac{h}{2\pi}$ mit $s = \pm \frac{1}{2}$	$ \tilde{j} = \sqrt{j(j+1)} \frac{h}{2\pi}$ $j = l+s , \dots, l-s $	
Richtung	$ \tilde{l}_z = m_l \frac{h}{2\pi}$ mit $m_l = -l, \dots, +l$	$ \tilde{s}_z = m_s \frac{h}{2\pi}$ mit $m_s = \pm \frac{1}{2}$	$ \tilde{j}_z = m_j \frac{h}{2\pi}$ mit $m_j = -j, \dots, +j$	
Energien: $E = m_d h \nu$ (ν : Lamorfrequenz)			Zahl der Zustände: $2d + 1$	

Beispiel d²

① $|l=2$ (d-Orbitale) $\mapsto M_L = -4, \dots +4$

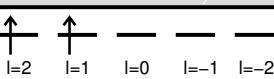
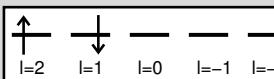
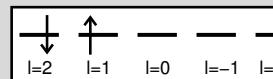
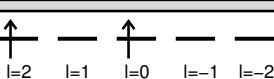
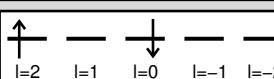
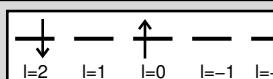
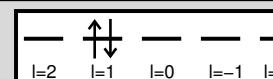
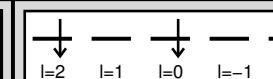
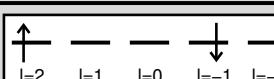
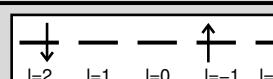
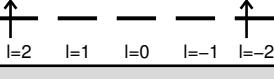
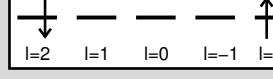
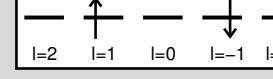
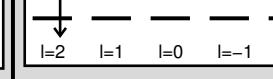
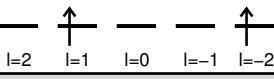
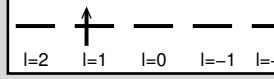
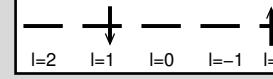
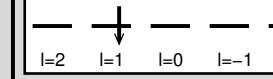
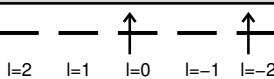
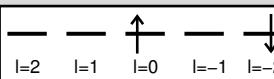
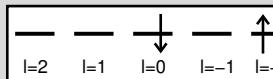
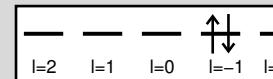
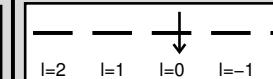
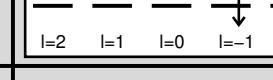
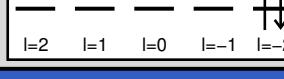
und $s = \frac{1}{2} \mapsto M_S = -1, \dots, +1$

Beispiel d²

M_S M_L	+1	0	-1
+4			
+3		 	
+2		  	
+1	 	 	
0	 	  	
-1	 	  	
-2	 	  	
-3	 	  	
-4			

② Tabelle mit $(2L+1)=9$ Zeilen und $(2S+1)=3$ Spalten

Beispiel d²

M_S M_L	+1	0	-1
+4		1G 	
+3	 l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2
+2	 l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2
+1	 l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2
0	 l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2
-1	 l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2
-2	 l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2
-3	 l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2  l=2 l=1 l=0 l=-1 l=-2	 l=2 l=1 l=0 l=-1 l=-2
-4		 l=2 l=1 l=0 l=-1 l=-2	

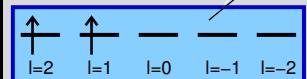
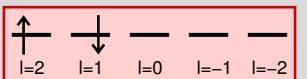
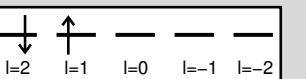
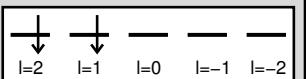
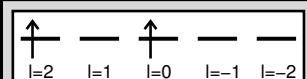
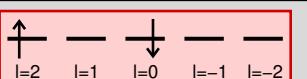
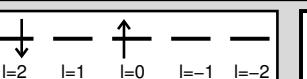
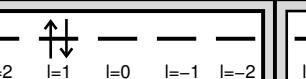
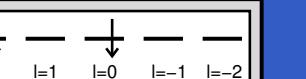
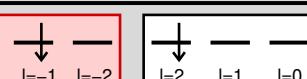
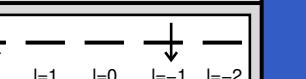
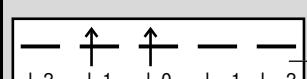
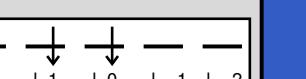
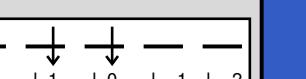
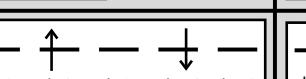
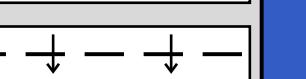
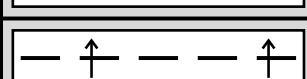
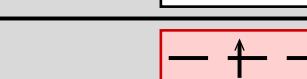
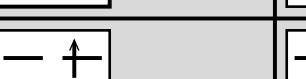
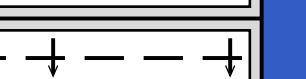
③ $M_L(\max) = +4$ und $M_S = 0 \rightarrow ^1 G$

Beispiel d²

M_S M_L	+1	0	-1
+4		1G	
+3			
+2			
+1			
0			
-1			
-2			
-3			
-4			

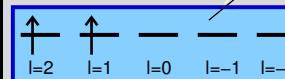
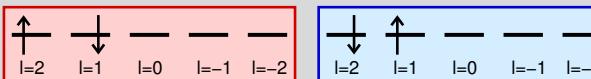
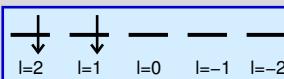
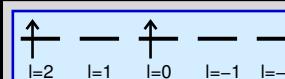
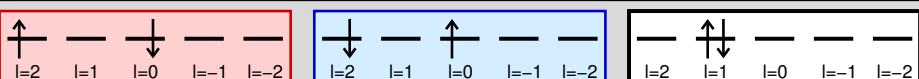
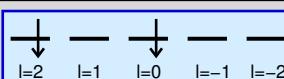
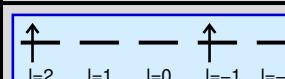
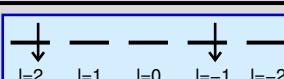
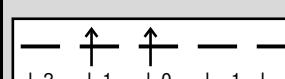
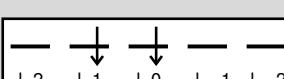
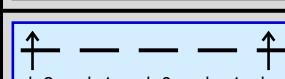
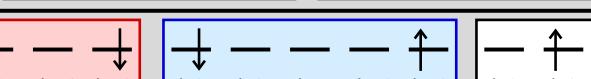
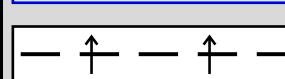
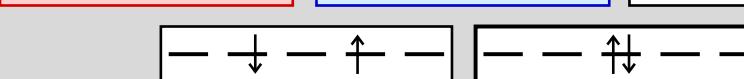
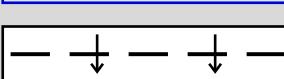
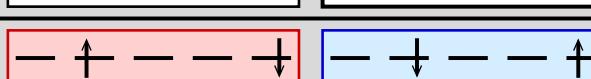
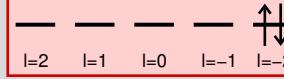
④ insgesamt $(2L+1)(2S+1)=9 \cdot 1 = 9$ entartete Zustände

Beispiel d²

M_S M_L	+1	0	-1
+4	$3F$	1G 	
+3		 	
+2	 	 	
+1	 	 	
0	 	  	
-1	 	 	
-2	 	 	
-3	 	 	
-4			

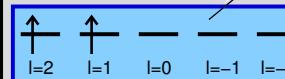
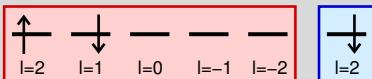
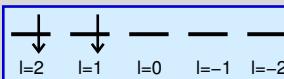
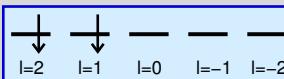
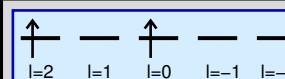
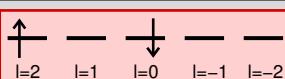
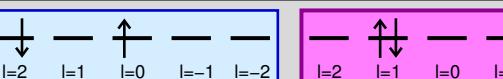
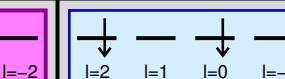
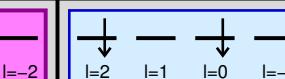
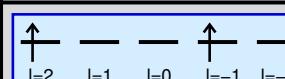
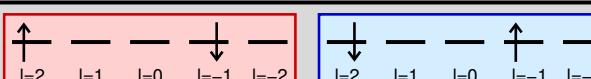
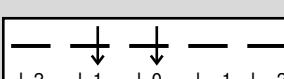
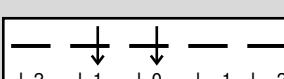
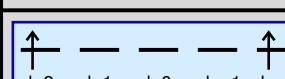
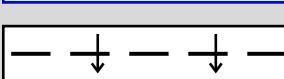
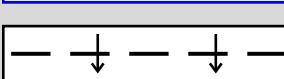
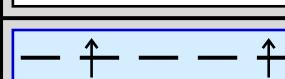
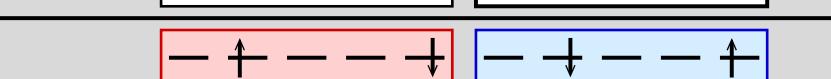
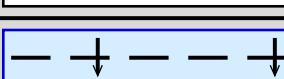
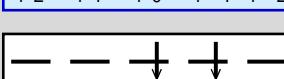
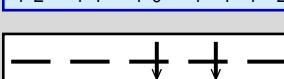
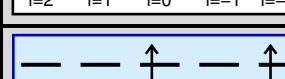
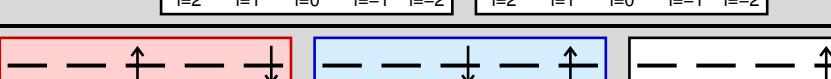
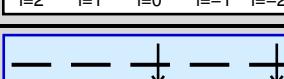
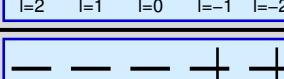
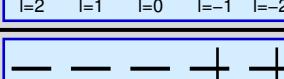
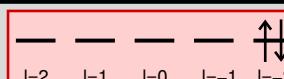
③ neues $M_L(\max) = +3$ und $M_S = +1 \mapsto ^3 F$

Beispiel d²

M_S M_L	+1	0	-1
+4	$3F$	1G 	
+3			
+2			
+1			
0			
-1			
-2			
-3			
-4			

④ insgesamt $(2L+1)(2S+1) = 7 \cdot 3 = 21$ entartete Zustände

Beispiel d²

$M_S \backslash M_L$	+1	0	-1
+4	$3F$	1G 	
+3		 	
+2		  	
+1	 	 	
0	 	 	
-1	 	 	
-2	 	 	
-3			
-4			

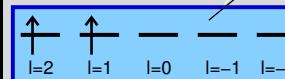
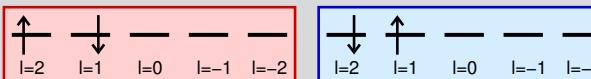
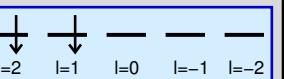
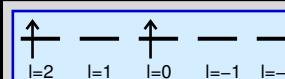
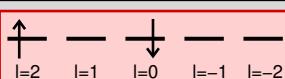
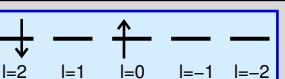
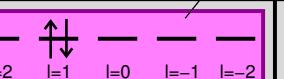
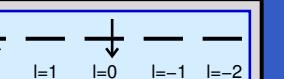
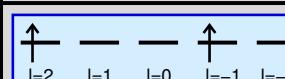
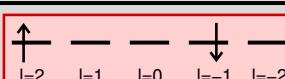
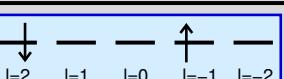
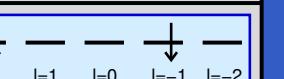
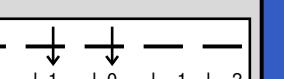
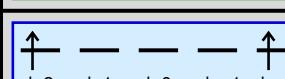
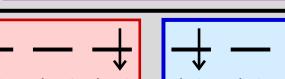
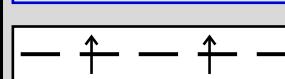
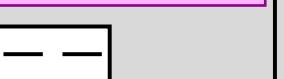
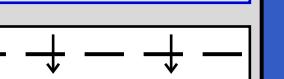
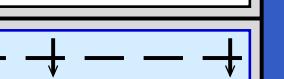
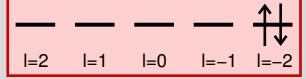
③ $M_L(\max) = 2$ und $M_S = 0 \mapsto ^1 D$

Beispiel d²

M_S M_L	+1	0	-1
+4	$3F$	1G [↑↓ ←→ ←→ ←→] l=2 l=1 l=0 l=-1 l=-2	
+3	[↑ ↑ ← → ← →] l=2 l=1 l=0 l=-1 l=-2	[↑ ↓ ← → ← →] l=2 l=1 l=0 l=-1 l=-2 [↓ ↑ ← → ← →] l=2 l=1 l=0 l=-1 l=-2	[↓ ↓ ← → ← →] l=2 l=1 l=0 l=-1 l=-2
+2	[↑ ← → ↑ ← →] l=2 l=1 l=0 l=-1 l=-2	[↑ ← → ↓ ← →] l=2 l=1 l=0 l=-1 l=-2 [↓ ← → ↑ ← →] l=2 l=1 l=0 l=-1 l=-2 [← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2	[↓ ← → ↓ ← →] l=2 l=1 l=0 l=-1 l=-2
+1	[↑ ← → ← → ↑] l=2 l=1 l=0 l=-1 l=-2	[↑ ← → ← → ↓] l=2 l=1 l=0 l=-1 l=-2 [↓ ← → ← → ↑] l=2 l=1 l=0 l=-1 l=-2	[↓ ← → ← → ↓] l=2 l=1 l=0 l=-1 l=-2
0	[↑ ← → ← → ↑] l=2 l=1 l=0 l=-1 l=-2	[↑ ← → ← → ↓] l=2 l=1 l=0 l=-1 l=-2 [↓ ← → ← → ↑] l=2 l=1 l=0 l=-1 l=-2 [← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2	[↓ ← → ← → ↓] l=2 l=1 l=0 l=-1 l=-2
-1	[↑ ← → ← → ↑] l=2 l=1 l=0 l=-1 l=-2	[↑ ← → ← → ↓] l=2 l=1 l=0 l=-1 l=-2 [↓ ← → ← → ↑] l=2 l=1 l=0 l=-1 l=-2	[↓ ← → ← → ↓] l=2 l=1 l=0 l=-1 l=-2
-2	[← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2	[← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2 [← → ↓ ↑ ← →] l=2 l=1 l=0 l=-1 l=-2 [← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2	[← → ↓ ↑ ← →] l=2 l=1 l=0 l=-1 l=-2
-3	[← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2	[← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2 [← → ↓ ↑ ← →] l=2 l=1 l=0 l=-1 l=-2	[← → ↓ ↑ ← →] l=2 l=1 l=0 l=-1 l=-2
-4		[← → ↑ ↓ ← →] l=2 l=1 l=0 l=-1 l=-2	

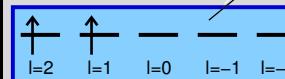
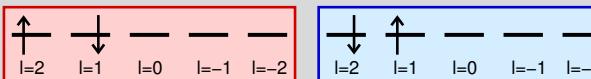
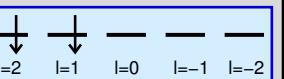
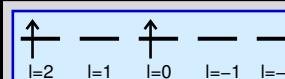
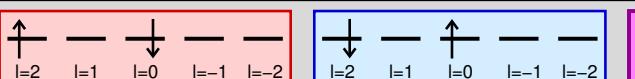
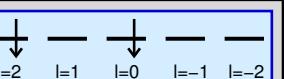
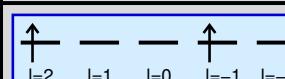
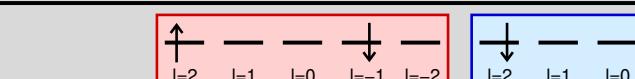
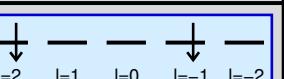
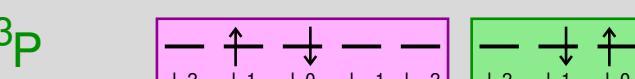
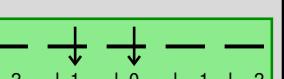
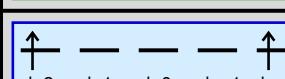
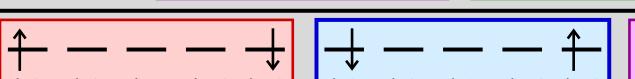
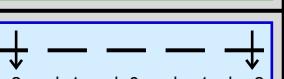
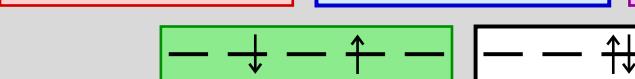
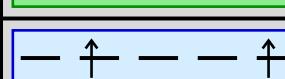
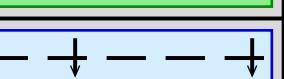
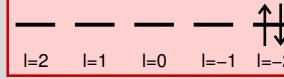
④ insgesamt $(2L+1)(2S+1)=5 \cdot 1 = 5$ entartete Zustände

Beispiel d²

$M_L \backslash M_S$	+1	0	-1
+4	$3F$	1G 	
+3			
+2		  	
+1		 	
0		  	
-1		 	
-2		  	
-3		 	
-4			

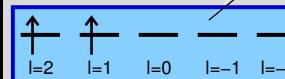
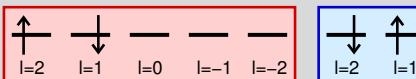
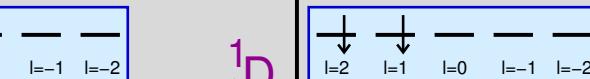
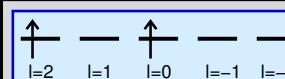
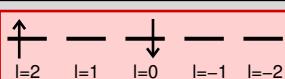
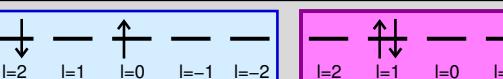
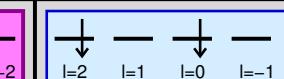
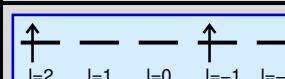
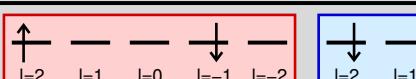
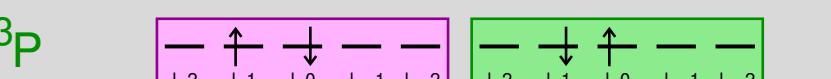
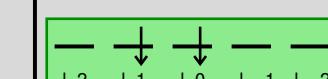
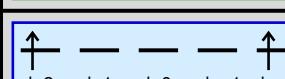
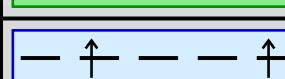
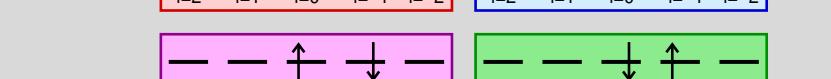
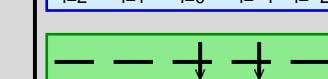
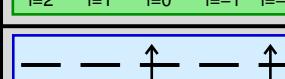
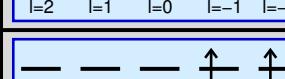
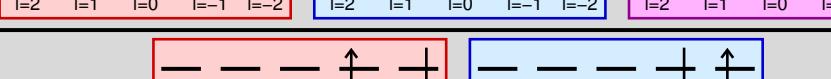
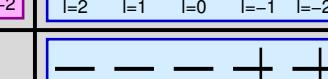
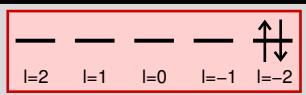
③ $M_L(\max) = +1$ und $M_S = 0 + 1 \mapsto ^3 P$

Beispiel d²

M_S M_L	+1	0	-1
+4	$3F$	1G 	
+3			
+2			
+1			
0			
-1			
-2			
-3			
-4			

④ insgesamt $(2L+1)(2S+1) = 3 \cdot 3 = 9$ entartete Zustände

Beispiel d²

$M_L \backslash M_S$	+1	0	-1
+4	$3F$	1G 	
+3		 	$1D$
+2		 	
+1			
0		 	
-1		 	
-2		 	
-3			
-4			

③ $M_L(\max) = 0$ und $M_S = 0 \mapsto ^1G \mapsto \text{ENDE}$