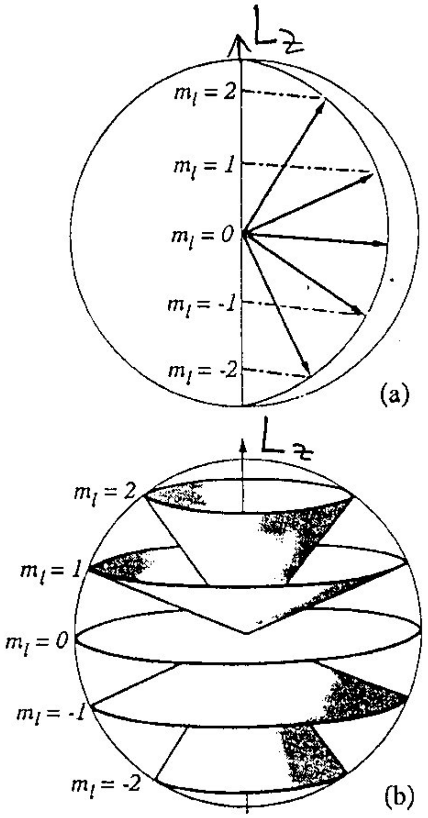
a) Projektion des Drehimpuls-Vektors $\vec{L}$ auf z-Achse



b) Kegelmantel der möglichen Orientierungen von $\vec{L}$ (a, b für $l = 2$)

Kugelflächenfunktionen $Y_{lm}(\theta, \phi)$

$$l = 0 \quad Y_{00} = \frac{1}{\sqrt{4\pi}}$$

$$l = 1 \quad \begin{cases} Y_{10} = \sqrt{\frac{3}{4\pi}} \cos\theta \\ Y_{11} = \sqrt{\frac{3}{8\pi}} \sin\theta e^{i\phi} \\ Y_{1-1} = \sqrt{\frac{3}{8\pi}} \sin\theta e^{-i\phi} \end{cases}$$

$$l = 2 \quad \begin{cases} Y_{20} = \sqrt{\frac{5}{4\pi}} \left(\frac{3}{2}\cos^2\theta - \frac{1}{2}\right) \\ Y_{2\pm1} = \sqrt{\frac{15}{8\pi}} \sin\theta\cos\theta e^{\pm i\phi} \\ Y_{2\pm2} = \frac{1}{4}\sqrt{\frac{15}{2\pi}} \sin^2\theta e^{\pm 2i\phi} \end{cases}$$

$$l = 3 \quad \begin{cases} Y_{30} = \sqrt{\frac{7}{4\pi}} \left(\frac{5}{2}\cos^3\theta - \frac{3}{2}\cos\theta\right) \\ Y_{3\pm1} = \frac{1}{4}\sqrt{\frac{21}{4\pi}} \sin\theta\left(5\cos^2\theta - 1\right) e^{\pm i\phi} \\ Y_{3\pm2} = \frac{1}{4}\sqrt{\frac{105}{2\pi}} \sin^2\theta\cos\theta e^{\pm 2i\phi} \\ Y_{3\pm3} = \frac{1}{4}\sqrt{\frac{35}{4\pi}} \sin^3\theta e^{\pm 3i\phi} \end{cases}$$

Reelle Linearkombinationen der Y_{lm}:

$$Y_{lm} + Y_{l-m} \sim \cos(m\phi)$$

$$\frac{Y_{lm} - Y_{l-m}}{i} \sim \sin(m\phi)$$