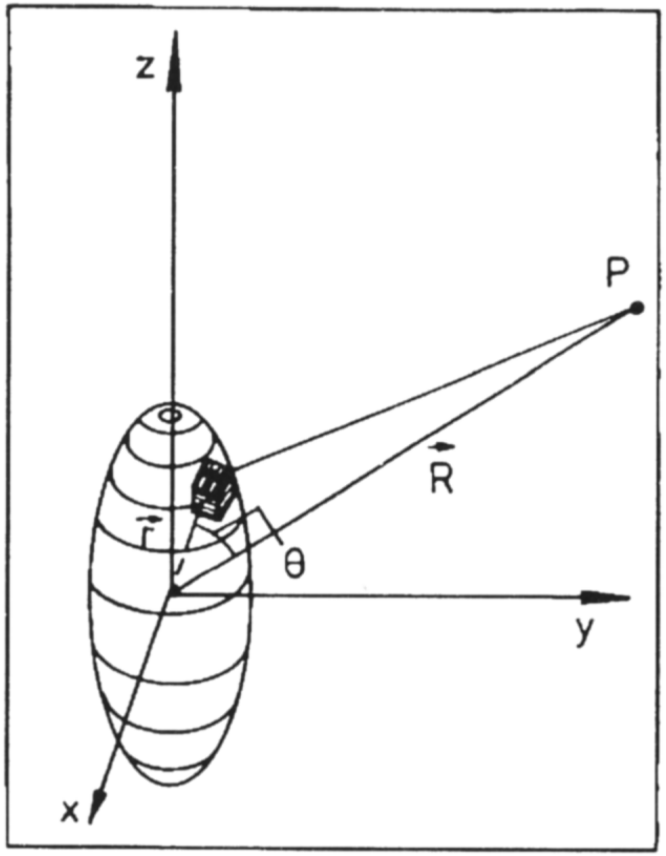
Elektromagnetische Momente

- Spin, Parität, Kernspin
- magnetisches Moment
- Quadrupolmoment

Quadrupolmoment

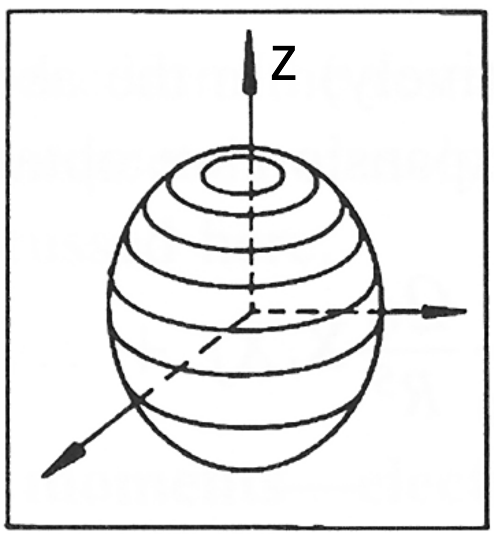


$$\Phi(\vec{R}) = \frac{1}{4\pi\varepsilon_0} \int \frac{\rho(\vec{r})}{|\vec{R}-\vec{r}|} d^3\vec{r}$$

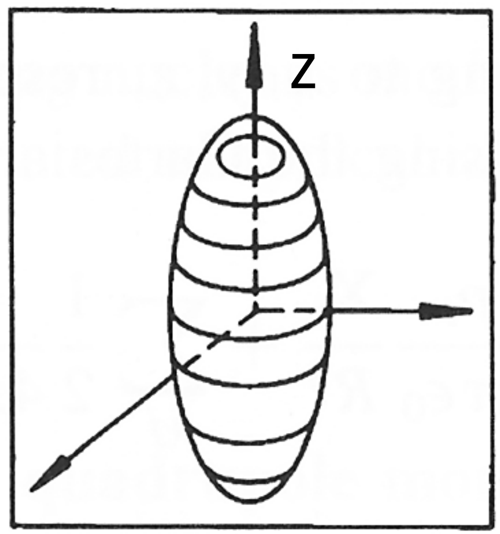
$$\Phi(\vec{R}) = \frac{1}{4\pi\varepsilon_0}\frac{q}{R} + \frac{1}{4\pi\varepsilon_0}\sum_i \frac{p_i}{R^3} X_i + \frac{1}{4\pi\varepsilon_0}\sum_i \frac{Q_{ij}}{R^5} X_i X_j$$

Quadrupolmoment

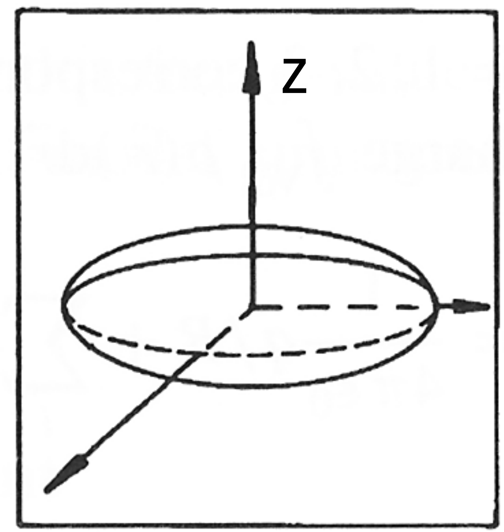
sphärisch



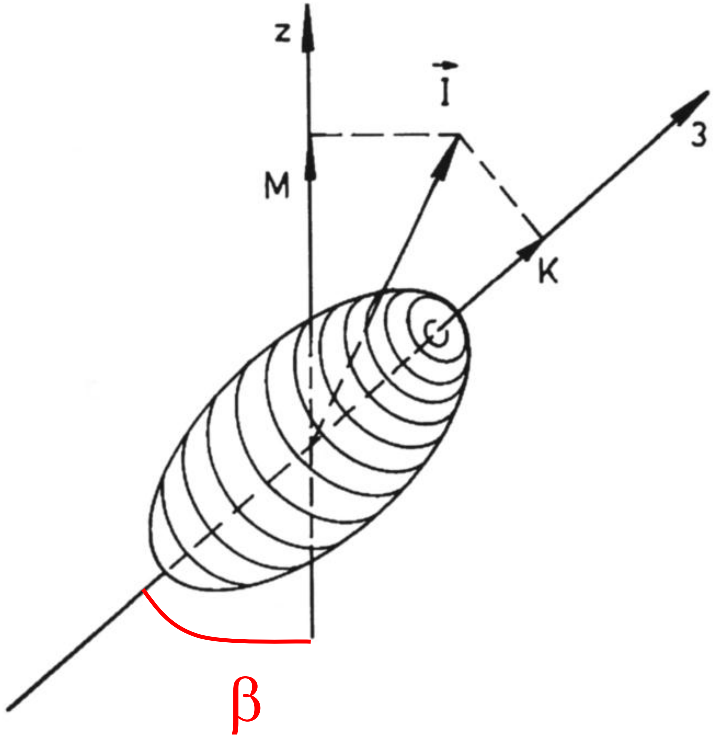
prolat



oblat



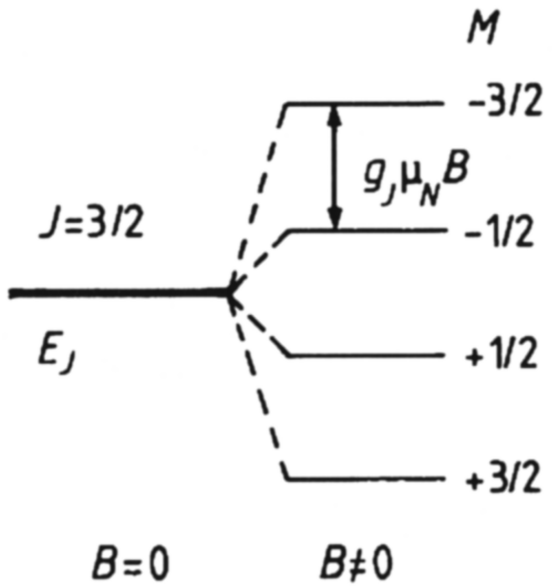
Quadrupolmoment



$$Q_{\mathrm{lab}} = \frac{1}{2}\left(3\cos^2\beta - 1\right)Q_{\mathrm{intr}}$$

$$\mathrm{Q}_{\mathrm{lab}} = \frac{3K^2 - I(I+1)}{(\mathrm{I}+1)(2\mathrm{I}+3)} \cdot \mathrm{Q}_{\mathrm{intr}}$$

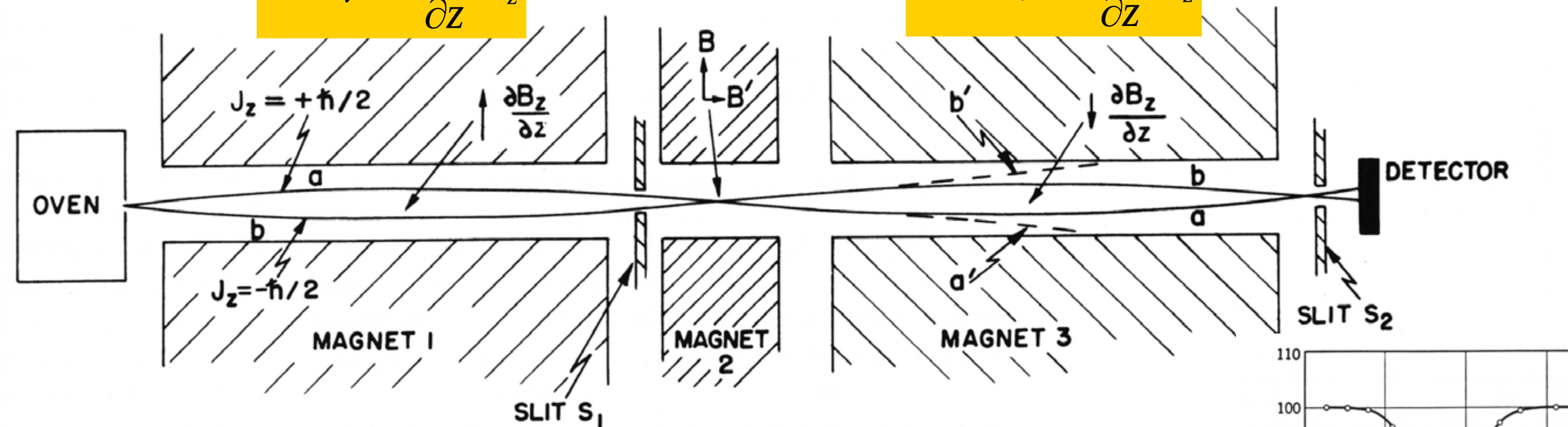
Zeeman-Effekt

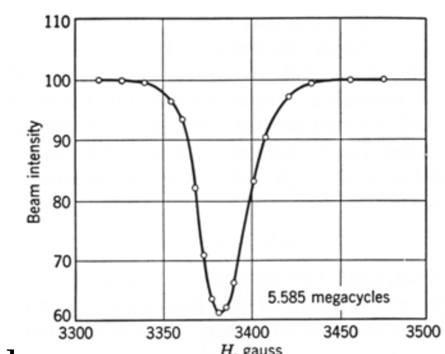


$$\Delta E_{M,M-1} = g_j \mu_K B$$

Atomstrahlexperiment nach Rabi

$$\vec{F} = \vec{\mu} \bullet \frac{\partial B_z}{\partial z} \vec{e}_z \qquad \vec{F} = -\vec{\mu} \bullet \frac{\partial B_z}{\partial z} \vec{e}_z$$



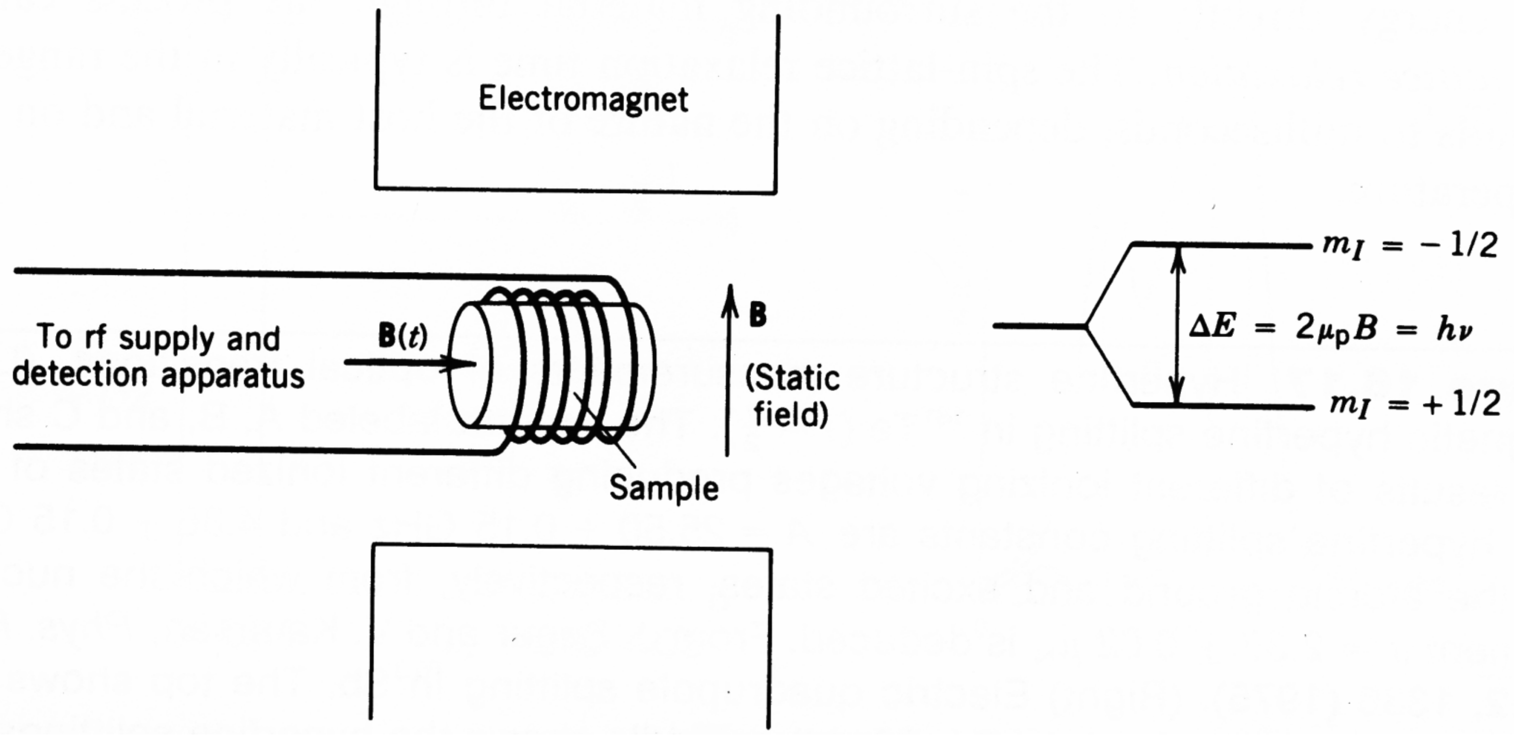


Randbedingungen:

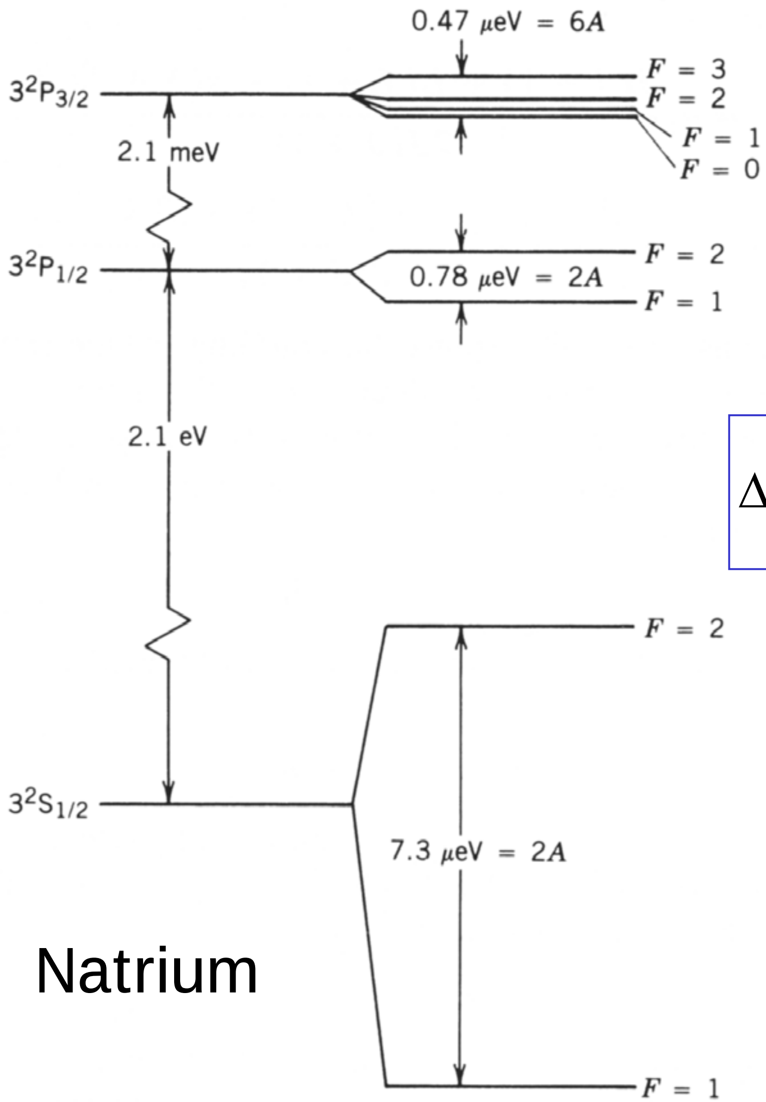
- B_1 und B_3 gleich groß, konstant entlang der Achse
- B_1 und B_3 haben entgegengesetzte Gradienten in vertikaler Richtung
- B_2 homogen

- Im Bereich von Magnet 2 wird ein RF Feld B(t) eingestrahlt
- B(t) ist senkrecht zu B_2 und kann Richtung von μ ändern!!

Kernspinresonanz (NMR)



Hyperfeinwechselwirkung



Natrium

F: 1→0   ΔE = A -B

F: 2→1   ΔE = 2A -B

F: 3→1   ΔE = 3A + B

A/h = 19,7 MHz

B/h = 3,3 MHz

$$\Delta E_{HF} = A \cdot \frac{C}{2} + B \cdot \frac{\frac{3}{2}C(C+1) - 2I(I+1)J(J+1)}{I(2I-1)J(2J-1)}$$

$$C = [F(F+1) - J(J+1) - I(I+1)]$$

$$A = \frac{\mu_N g_I B_J(0)}{J}$$

$$B = eQ_{lab}\left(\frac{\partial^2 V}{\partial z^2}\right)_0 = eQ_{lab}\left(\frac{\partial \mathcal{E}}{\partial z}\right)_0$$