# 1. Magnetfeld eines Koaxialkabels

For $r \leq R_1$:

$$I_{in} = I \frac{r^2}{R_1^2}$$
$$I_{in}\mu_0 = \oint \vec{B}(\vec{r})\,\mathrm{d}\vec{s} = B(r)\oint \mathrm{d}s = B(r)2r\pi$$
$$B(r) = \frac{I\mu_0}{2\pi R_1^2} r$$

For $R_1 \leq r \leq R_2$:

$$I_{in} = I$$
$$I_{in}\mu_0 = \oint \vec{B}(\vec{r})\,\mathrm{d}\vec{s} = B(r)\oint \mathrm{d}s = B(r)2r\pi$$
$$B(r) = \frac{I\mu_0}{2\pi}\frac{1}{r}$$

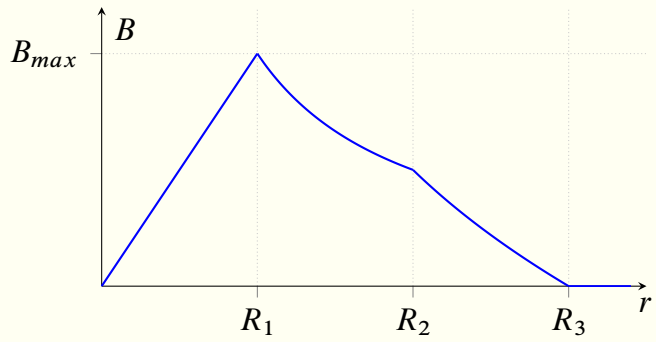
For $R_2 \leq r \leq R_3$:

$$I_{in} = I\left(1 - \frac{r^2-R_2^2}{R_3^2-R_2^2}\right)$$
$$I_{in}\mu_0 = \oint \vec{B}(\vec{r})\,\mathrm{d}\vec{s} = B(r)\oint \mathrm{d}s = B(r)2r\pi$$
$$B(r) = \frac{I\mu_0}{2\pi}\left(\frac{1}{r} - \frac{r^2-R_2^2}{r(R_3^2-R_2^2)}\right)$$

For $R_3 \leq r$:

$$I_{in} = 0$$
$$B(r) = 0$$

$$B(r) = \begin{cases} \frac{I\mu_0}{2\pi R_1^2} r & \text{for } 0 < r \leq R_1, \\ \frac{I\mu_0}{2\pi}\frac{1}{r} & \text{for } R_1 \leq r \leq R_2, \\ \frac{I\mu_0}{2\pi}\left(\frac{1}{r} - \frac{r^2-R_2^2}{r(R_3^2-R_2^2)}\right) & \text{for } R_2 \leq r \leq R_3, \\ 0 & \text{for } R_3 \leq r. \end{cases}$$




## 2. Anwendung des Gesetzes von Biot-Savart – „Haarnadel“

$$\mathrm{d}\vec{B}_1 = \frac{\mu_0 I}{4\pi}\frac{\mathrm{d}\vec{l}\times\vec{r}}{r^3} = \frac{\mu_0 I}{4\pi}\frac{\mathrm{d}l\sin(\theta)}{r^2} = \frac{\mu_0 I}{4\pi}\frac{\mathrm{d}\varphi R^2}{r^3}$$

$$B_1 = \frac{\mu_0 I}{4\pi}\frac{R^2}{r^3}\int_0^{\pi} 1\,\mathrm{d}\varphi = \frac{\mu_0 I}{4}\frac{R^2}{r^3}$$

$$\mathrm{d}\vec{B}_2 = \frac{\mu_0 I}{4\pi}\frac{\mathrm{d}\vec{l}\times\vec{r}}{r^3} = \frac{\mu_0 I}{4\pi}\frac{\mathrm{d}l\sin(\theta)}{r^2} = \frac{\mu_0 I}{4\pi}\frac{\mathrm{d}lR}{r^3}$$

## 3. Drehmoment auf rechteckige Leiterschleife

a)

b)