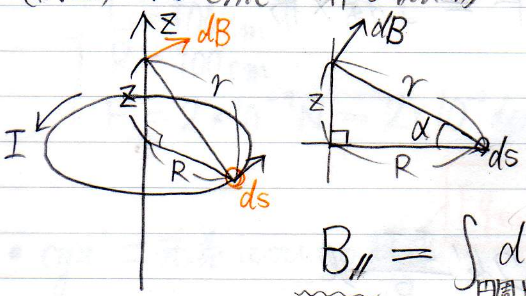
(例1) 直線電流がつくる電場

$$B = \int dB = k' \int_{-\infty}^{\infty} \frac{I\,dz}{(R^2+z^2)} \cdot \frac{R}{(R^2+z^2)^{1/2}} \quad \sin\theta$$

$$= 2k' I \int_{-\infty}^{\infty} \frac{R\,dz}{(R^2+z^2)^{3/2}} \quad \leftarrow z = R\tan\varphi$$

$$= 2k' \frac{I}{R}$$

(例2) 円電流が作る磁場



B：zの関数

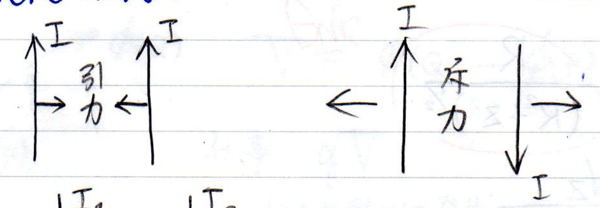
$$dB = k' \frac{I\,ds \times 1}{r^2}$$

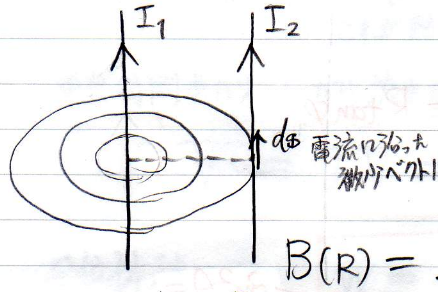
$$\underbrace{B_{/\!/}}_{z成分} = \int_{円周上} dB \cos\alpha = (2\pi R)\, I \frac{1}{r^2} k' \frac{R}{r} \quad \cos\alpha$$

$$\therefore B_{/\!/}(z) = 2\pi k' I \frac{R^2}{(R^2+z^2)^{3/2}}$$

特に、$z=0$ では、$B_{/\!/}(0) = 2\pi k' \dfrac{I}{R}$

Ampereの力.



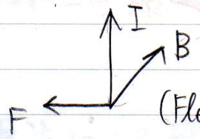


$$B(R) = 2k'\frac{I}{R}$$

静電場Bのなかに強さIの定常電流を持ってきたときに、その素片Idsが受ける力

$$dF = I ds \cdot B$$

$$d\mathbf{F} = I d\mathbf{s} \times \mathbf{B}$$



(Fleming の左手の法則)

$$B(R) = (2k')\frac{I_1}{R}$$

$$F = \int dF = I_2 B \int ds = I_2 B l = 2k'\frac{I_1 I_2}{R} l$$

$$\boxed{F = 2k'\frac{I_1 I_2}{R} l}$$ (アンペールの力)

電磁気学の単位系 II

平行電流間の力 $F = (2k')\frac{I_1 I_2}{R} l$

$$\begin{cases} k' = 1 & : 三元単位系\ (非有理化) \\ k' = \frac{1}{4\pi} & : 三元単位系\ (有理化) \end{cases}$$

・L, M, T とは独立に電流の単位を決める：四元単位系

例1 三元非有理化(電磁単位系) electromagnetic unit (emu)

$$I_1 = I_2 = 1 \quad \begin{cases} l = 1\,\mathrm{cm} \\ R = 1\,\mathrm{cm} \\ F = 2\,\mathrm{dyn} \end{cases} \quad I = 1\ \mathrm{(cgs)\ emu}\ (\equiv 1\ \mathrm{abampere})$$