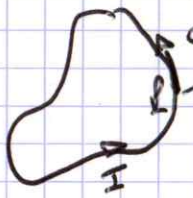
Champ mag créé par courant permanent

1. Biot et Savart

Soit un circuit filiforme C orienté, parcouru par un courant I permanent.

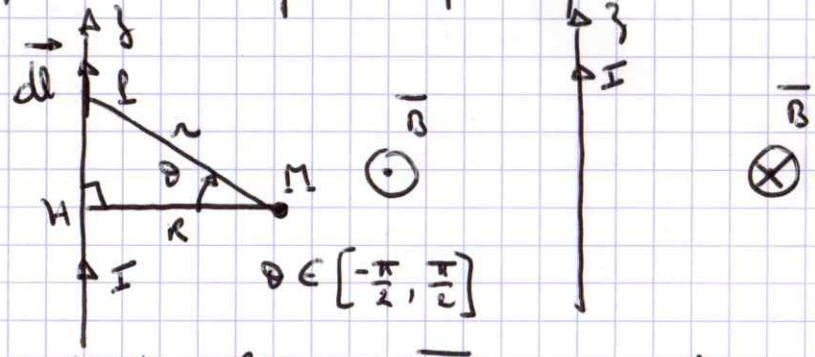
$$\vec{B}(M) = \frac{\mu_0}{4\pi} \oint_{(C)} I \frac{d\vec{l} \wedge \vec{u}}{r^2}$$

où $\vec{r} = \overrightarrow{PM}$ et $\vec{u} = \frac{\overrightarrow{PM}}{r}$, $\mu_0 = 4\pi 10^{-7} \frac{T\,m}{A}$



$d\vec{l}$ in sens que I

Applications : fil rectiligne infini



$r = \|\overrightarrow{PM}\| = \frac{R}{\cos\theta}$ $\quad \overline{HI} = z = R \tan\theta$

$dz = R \frac{d\theta}{\cos^2\theta}$

$$d\vec{l} \wedge \vec{r} = d\vec{l} \wedge \overrightarrow{IM} = d\vec{l} \wedge (\overrightarrow{PH} + \overrightarrow{HM})$$

$$= d\vec{l} \wedge \overrightarrow{HM} = R\,dz\,\vec{e}_\theta$$

$$d\vec{l} \wedge \vec{r} = R^2 \frac{d\theta}{\cos^2\theta} \vec{u}_\theta$$

$$d\vec{B} = \frac{\mu_0}{4\pi} I \frac{d\vec{l} \wedge \vec{r}}{r^3} = \frac{\mu_0 I}{4\pi} \frac{R^2\,d\theta}{\cos^2\theta} \frac{\cos^3\theta}{R^3} \vec{u}_\theta$$

$$d\vec{B} = \frac{\mu_0 I}{4\pi} \frac{\cos\theta}{R} d\theta\, \vec{u}_\theta \quad \text{. Notons que } \vec{u}_\theta \neq f(\theta)$$

$$\vec{B} = \frac{\mu_0 I}{4\pi R} \int_{-\pi/2}^{\pi/2} \cos\theta\, d\theta\, \vec{u}_\theta = \frac{\mu_0 I}{2\pi R}$$