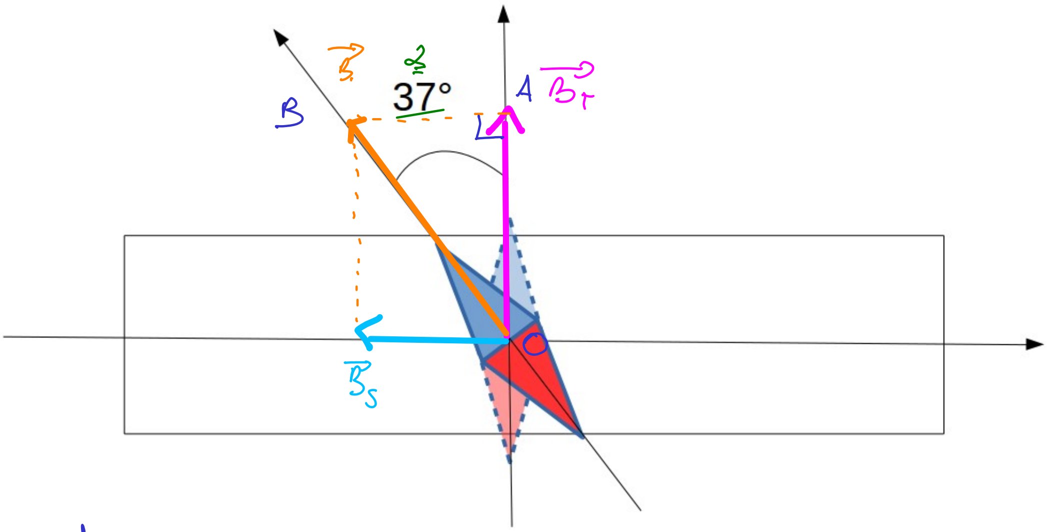
TD EM 1
Champ magnétique

EM1. Champ magnétique terrestre



On cherche B_T.

On connaît $B_S = \mu_0 \times \frac{Ni}{L}$

On mesure $\alpha = 37°$

Dans le triangle OAB rectangle en A :

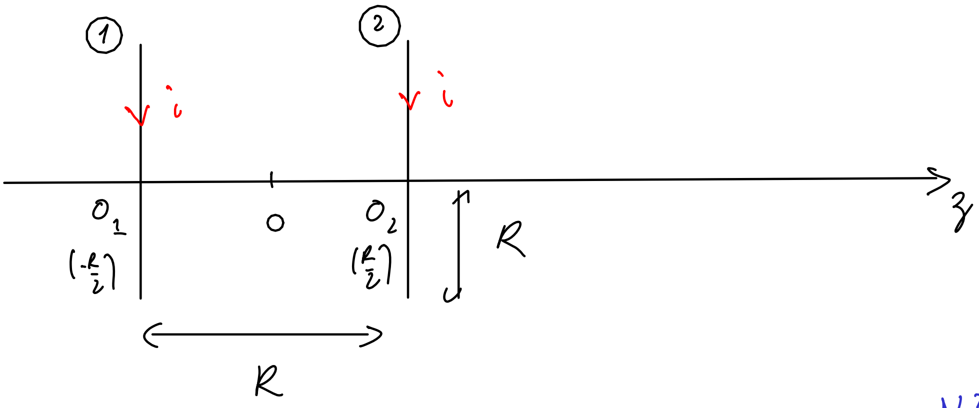
$$\tan\alpha = \frac{B_S}{B_T} \Rightarrow B_T = \frac{B_S}{\tan\alpha}$$

$$\Leftrightarrow \boxed{B_T = \frac{\mu_0 N i}{L \tan\alpha}}$$

A.N. :

$$\left.\begin{aligned} \mu_0 &= 4\pi \times 10^{-7}\ H.m^{-1} \\ L &= 10\ cm \\ I &= 56\ mA \\ N &= 130 \end{aligned}\right\} \quad \underline{B_T \approx 3{,}5 \times 10^{-5}\ T}$$

EM2 - Bobines de Helmholtz



champ par une bobine : $\vec{B}(0,0,z) = \frac{\mu_0}{2} \frac{N I R^2}{(R^2+(z-z_0)^2)^{3/2}} \vec{e_z}$

1/ $\vec{B}_{tot} = \vec{B}_1 + \vec{B}_2$ (th de superposition)

avec $\vec{B}_1 = \frac{\mu_0 N I R^2}{2(R^2+(z+\frac{R}{2})^2)^{3/2}} \vec{e_z}$ et $\vec{B}_2 = \frac{\mu_0 N I R^2}{2(R^2+(z-\frac{R}{2})^2)^{3/2}} \vec{e_z}$

2/

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import numpy as np
import matplotlib.pyplot as plt

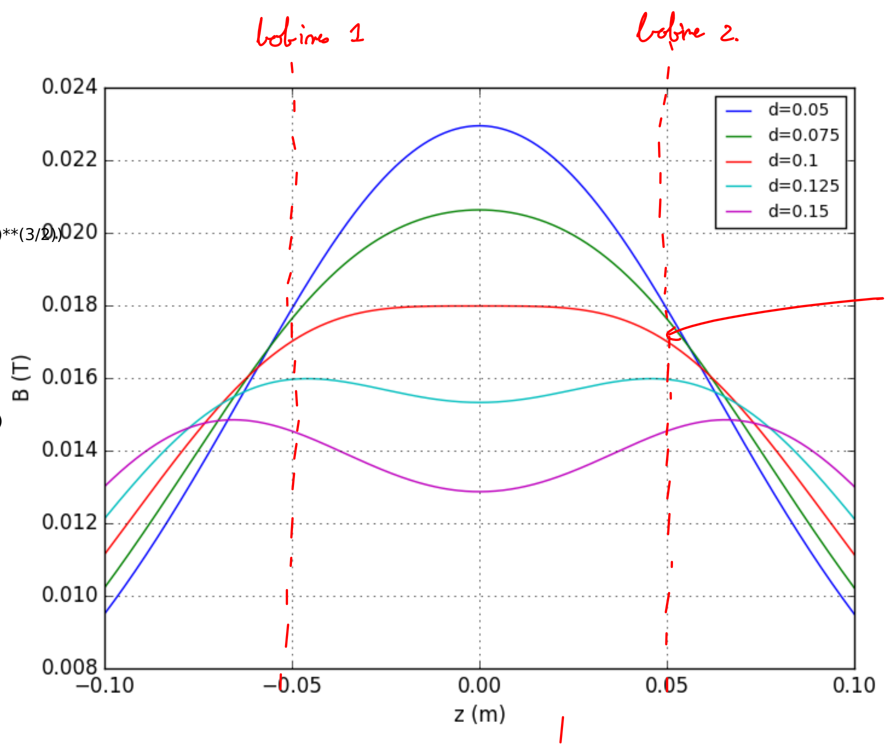
mu_0=4*np.pi*1e-7
R=1e-1
N=200
I=1

def B(z):
    return mu_0*N*I*R/(2*(R**2+z**2)**(3/2))


distance=np.linspace(R/2,3*R/2,5)
z=np.linspace(-R,R,1000)

for d in distance:
    Btot=B(z-d/2)+B(z+d/2)
    plt.plot(z,Btot,label='d='+str(d))
    plt.legend(loc=0,fontsize="small")

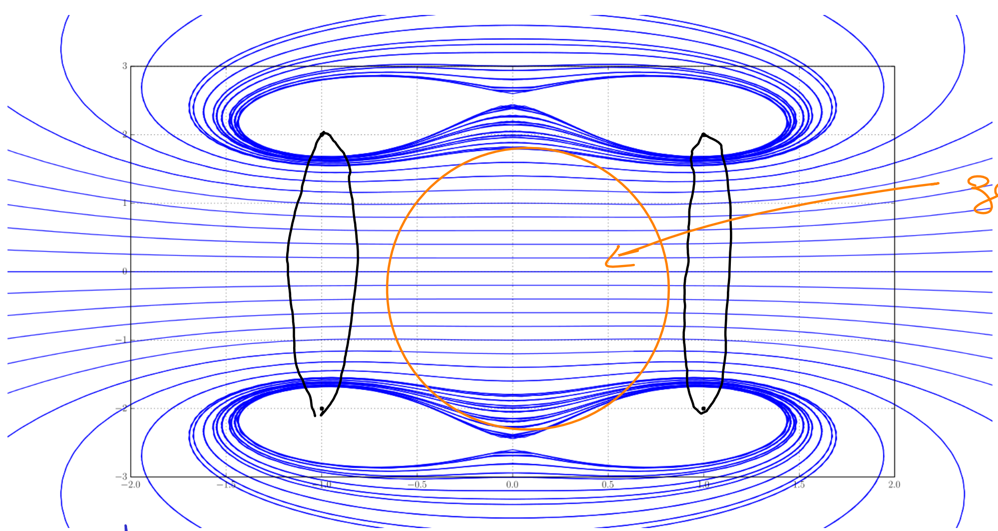
plt.xlabel('z (m)')
plt.ylabel('B (T)')
plt.xlim(-R,R)
plt.grid()
plt.show()
```



$R = 0{,}1$

pour $d = R$ champ sur l'axe quasiment homogène entre les bobines

3/

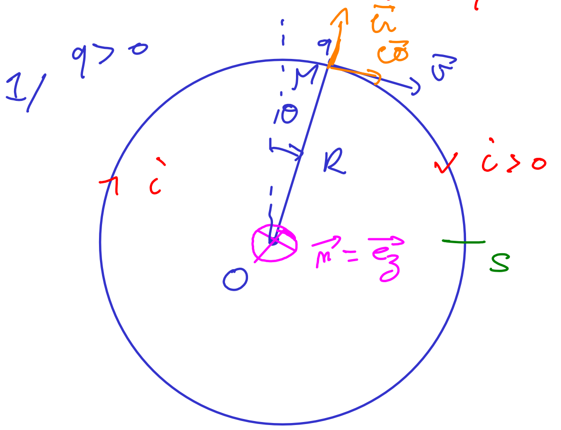


zone de champ uniforme.

Les lignes de champ tournent autour des bobines.

EM3 - Moment magnétique orbitale

1/ $q > 0$



$$\boxed{I = \frac{q}{T}}$$

2/ $\vec{m} = IS\vec{n} = I\pi R^2\vec{n} = \boxed{I\pi R^2\vec{e_z} = \vec{m}}$

3/ $\vec{L_O} = \vec{OM} \wedge m\vec{v}$ avec $\vec{OM} = R\vec{e_r}$ et $\vec{v} = R\dot{\theta}\vec{e_\theta}$

$\Rightarrow \boxed{\vec{L_O} = mR^2\dot{\theta}\vec{e_z}}$

$$\frac{m}{L_O} = \frac{\pi R^2 I}{mR^2\dot{\theta}} = \frac{\cancel{\pi}\cancel{R^2} \times q}{m\cancel{R^2}\underbrace{\dot{\theta}T}_{2\cancel{\pi}}} = \frac{q}{2m}$$) facteur gyromagnétique.

4/ Atome d'hydrogène : $L = \hbar$

Moment magnétique : $\boxed{\mu_B = \left|\frac{e\hbar}{2m_e}\right|}$ magnéton de Bohr.