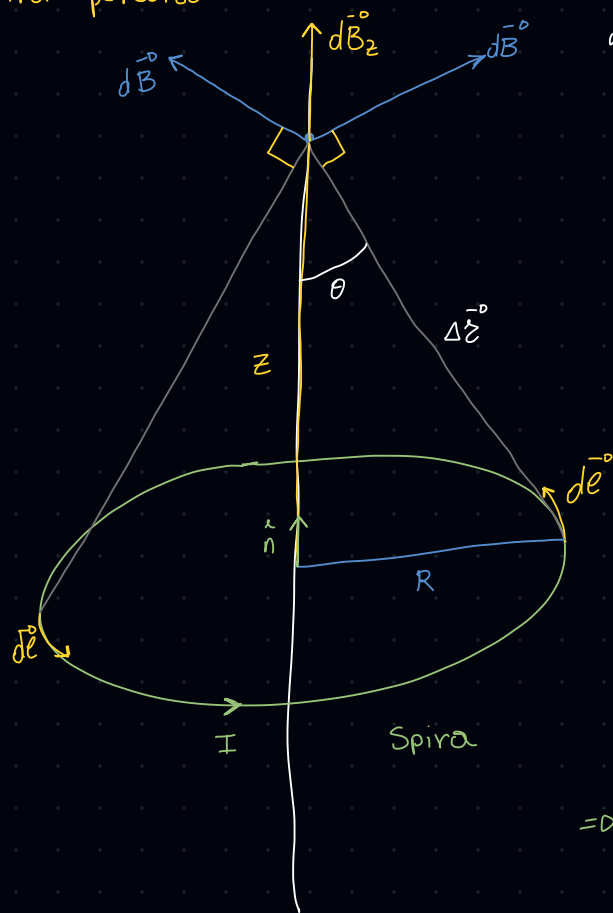
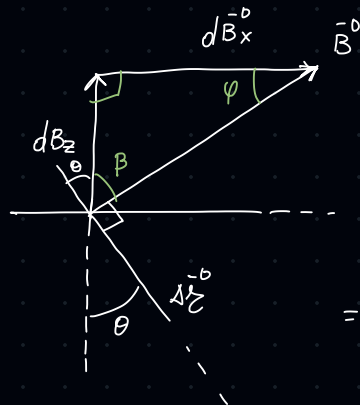


Spira percorsa da corrente



Le componenti x e y di \vec{B} si annullano a due a due $\Rightarrow \vec{B} = \vec{B}_z$

Da Laplace $d\vec{B} = \frac{\mu_0 I}{4\pi} \frac{d\vec{e} \wedge \Delta\vec{r}}{\Delta r^3}$



$$180 - \varphi - \beta$$

$$\beta = 180 - 90 - \theta$$

$$\Rightarrow \varphi = 180 - 90 - 180 + 90 + \theta = \theta$$

$$\Rightarrow B_z = B \sin \theta$$

$$\begin{aligned} \Rightarrow d\vec{B}_z &= \frac{\mu_0 I}{4\pi} \oint \frac{d\vec{e} \wedge \Delta\vec{r}}{\Delta r^3} \cdot \sin \theta = \kappa \oint \frac{d\vec{e} \cdot \Delta\vec{r} \cdot \sin(90)}{\Delta r^3} \cdot \sin(\theta) = \kappa \cdot \frac{\sin \theta}{\Delta r^2} \oint d\vec{e} \\ &= \frac{\mu_0 I}{4\pi} \cdot \frac{\sin \theta}{\Delta r^2} \cdot 2\pi R = \frac{\mu_0 I}{2} \cdot \frac{R \sin \theta}{\Delta r^2} \end{aligned}$$

$$\Delta r \cdot \sin \theta = R \Rightarrow \sin \theta = \frac{R}{\Delta r}, \quad \Delta r^2 = R^2 + z^2$$

$$\Rightarrow \frac{\mu_0 I}{2} \frac{R^2}{(R^2 + z^2)^{\frac{3}{2}}}$$

Campo \vec{B} di un Solenoide



N = Numero di spire, n = spire per unità di lunghezza

$$\Rightarrow n = \frac{N}{L}$$

$\Rightarrow n dz$ = Spire nella porzione dz

$$\Rightarrow B_{TOT} = \int_{-\frac{e}{2}}^{\frac{e}{2}} B_{spira} \cdot n dz = \frac{\mu_0 I}{2} \int_{-\frac{e}{2}}^{\frac{e}{2}} \frac{\overset{\text{Costante}}{R^2}}{\underset{\text{Non costante}}{(R^2 + z^2)^{\frac{3}{2}}}} \cdot n dz$$

$$\Rightarrow \int \frac{1}{(R^2 + z^2)^{\frac{3}{2}}} dz = \frac{1}{R^2} \frac{z}{\sqrt{R^2 + z^2}} + C$$

$$\begin{aligned} \Rightarrow \vec{B}_{TOT} &= \hat{n} \frac{\mu_0 I R^2}{2} n \left[\frac{1}{R^2} \cdot \frac{z}{\sqrt{R^2 + z^2}} \right]_{-\frac{e}{2}}^{\frac{e}{2}} = \hat{n} \frac{\mu_0 I}{2} n \left[\frac{1}{R^2} \cdot \frac{e}{2\sqrt{R^2 + (\frac{e}{2})^2}} + \frac{1}{R^2} \cdot \frac{e}{2\sqrt{R^2 + (\frac{e}{2})^2}} \right] \\ &= \hat{n} \mu_0 I \cancel{R^2} \cdot \frac{N}{2e} \cdot 2 \left[\frac{e}{\cancel{R^2} \cdot 2\sqrt{R^2 + \frac{e^2}{4}}} \right] \sqrt{\frac{4R^2 + e^2}{4}} = \frac{\sqrt{4R^2 + e^2}}{\cancel{2} \sqrt{4}} \\ &= \hat{n} \mu_0 I R^2 \cdot \frac{N}{\cancel{e}} \cdot \frac{e}{\sqrt{4R^2 + e^2}} \end{aligned}$$

Approx $e \gg R \Rightarrow \sqrt{4R^2 + e^2} = e$

$$\Rightarrow \vec{B} = \hat{n} \mu_0 I \left(N \cdot \frac{1}{e} \right) n \quad \Rightarrow \quad \vec{B} = \hat{n} \mu_0 I n$$

