Föreläsning 13/11-13

$$\mathbb{m} = i\int_S d\mathbb{S}$$

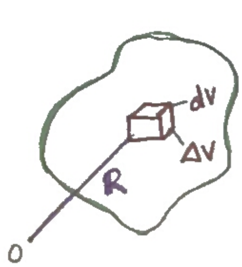
$$\mathbb{A}(\mathbb{R}_2) = \frac{\mu_0}{4\pi}\,\mathbb{m}\times\frac{\mathbb{R}_2}{R_2^3}$$

I sfäriska koordinater med $d\mathbb{S}$ i z-led:

$$\mathbb{A}(R,\theta,\phi) = \hat{\phi}\,\frac{\mu_0}{4\pi}\,m\,\frac{\sin\theta}{R^2}$$

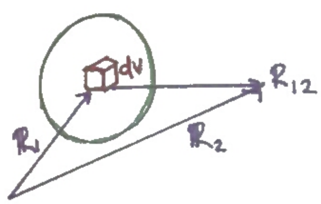
$$\mathbb{B} = \nabla\times\mathbb{A} = \frac{\mu_0 m}{4\pi R^3}\left(\hat{R}\,2\cos\theta + \hat{\theta}\sin\theta\right)$$

Magnetiseringsfältet $\mathbb{M}$ 6.6 (ej 6.6.1)



$$\mathbb{M} = \lim_{\Delta V\to 0}\frac{\sum_{k=1}^{n\Delta V} m_k}{\Delta V} \qquad [A/m]$$

eller $\frac{d\mathbb{m}}{dV} = \mathbb{M}$



$$d\mathbb{A}_m(\mathbb{R}_2) = \frac{\mu_0}{4\pi}\,\frac{\overbrace{\mathbb{M}\,dV}^{d\mathbb{m}}\times\mathbb{R}_{12}}{R_{12}^3}$$

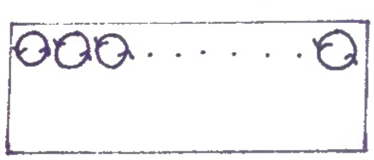
$$\mathbb{A}_m(\mathbb{R}_2) = \int_{V'}\frac{\mu_0}{4\pi}\,\frac{\mathbb{M}\times\mathbb{R}_{12}}{R_{12}^3}\,dV' = \ldots =$$

$$= \frac{\mu_0}{4\pi}\int_{V'}\frac{\nabla_1\times\mathbb{M}(\mathbb{R}_1)}{R_{12}}\,dV' + \frac{\mu_0}{4\pi}\oint_S\frac{\mathbb{M}(\mathbb{R}_1)}{R_{12}}\times d\mathbb{S}$$

Identifiera $\mathbb{J}_m(\mathbb{R}_1) = \nabla\times\mathbb{M}(\mathbb{R}_1) \longleftarrow$ Magnetiseringsströmtäthet

$\mathbb{J}_{ms}(\mathbb{R}_1) = \mathbb{M}\times\hat{n} \longleftarrow$ yt— " —

Tvärsnitt hos magnetiskt material:



H-fältet 6.7

Postulatet säger: $\frac{1}{\mu_0}\nabla\times \mathbb{B} = \mathbb{J}_{fri} + \mathbb{J}_m = (\mathbb{J} + \nabla\times \mathbb{M})$

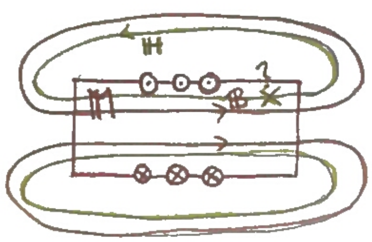
$\nabla\times\left(\frac{\mathbb{B}}{\mu_0} - \mathbb{M}\right) = \mathbb{J}_{fri}$ Definiera: $\mathbb{H} = \frac{\mathbb{B}}{\mu_0} - \mathbb{M}$, $\underbrace{\nabla\times\mathbb{H} = \mathbb{J}_{fri}}_{\text{postulatet med } \mathbb{H}\text{-fältet.}}$

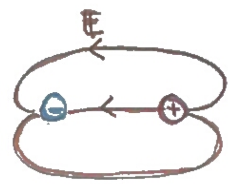
$\Leftrightarrow \oint_C \mathbb{H}\cdot d\mathbb{l} = i_{fri}$

Låt $\mathbb{M} = \chi_m \mathbb{H}$

$\mathbb{B} = \mu_0(\mathbb{H} + \mathbb{M}) = \mu_0\underbrace{(1+\chi_m)}_{\mu_r}\mathbb{H} = \mu_0\mu_r\mathbb{H}$

$\mathbb{H} = \frac{\mathbb{B}}{\mu_0} - \mathbb{M}$





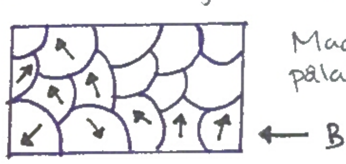
Randvillkor B & H 6.10

$\nabla\cdot\mathbb{B} = 0 \Rightarrow \mathbb{B}_{1n} = \mathbb{B}_{2n}$

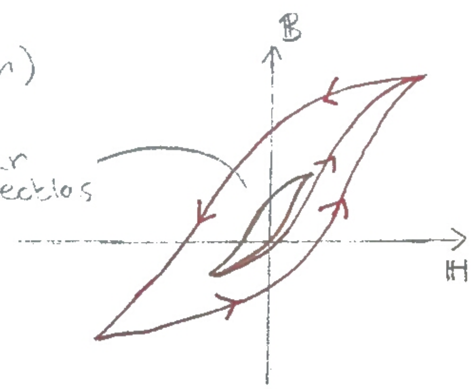
$\nabla\times\mathbb{H} = \mathbb{J} \Rightarrow (\mathbb{H}_1 - \mathbb{H}_2)_{tang.} = \mathbb{j}_s \times \hat{\mathbb{n}}_2$ om $\mathbb{j}_s = 0 \Rightarrow H_{1t} = H_{2t}$

Hysteres värme 6.9

En feromagnet $\mu_r >> 1$



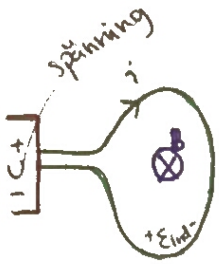
Magnetiska domäner utan pålagt fält (t.ex i gjutjärn)



Arean motsvarar värmeeffekt som utvecklas då vi omorienterar domänerna.

Induktans 6.11

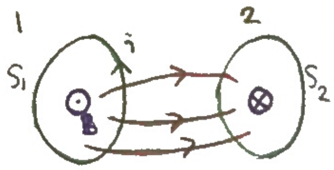
Faradays induktionslag: $\nabla \times \mathbb{E} = -\frac{\partial \mathbb{B}}{\partial t}$ (postulat)



självinduktans

$$\varepsilon_{ind} = -\frac{d\Phi}{dt} = -\frac{d(L \cdot i)}{dt} = -L\frac{di}{dt}$$

Ömsesidig induktans



(Har två slingor där ena inducerar i den andra, kallas ömsesidig induktans.)

Flöde från slinga 1 i 2.

$$\Phi_{12} = \int \mathbb{B}_1 \, d\mathbb{S}_2 = L_{12} \, i_1$$

ömsesidig induktans

Flera varv i slingan

Länkat flöde: $\Lambda_{12} = N_2 \int \mathbb{B}_1 \, d\mathbb{S}_2 = L_{12} \, i \quad \propto N_1 N_2 \, i_1$

antal varv i slinga 2

Självinduktans: $\Lambda_{11} = L_{11} \, i_1 \propto N_1^2 \, i_1$