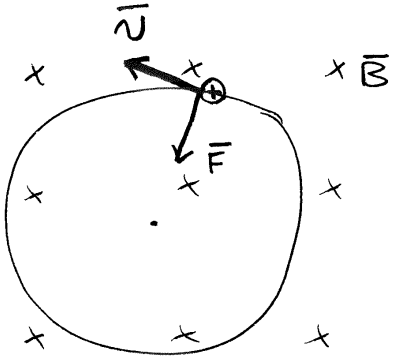
27 Hreyfing agna í segulsviði

Ögn í föstu segulsviði

$\rightarrow \bar{F} \perp \bar{v}$

engin breyting á hreyfiorku

Ef $\bar{v} \perp \bar{B}$ $\rightarrow$ hringhreyfing (jöfn)



$$\bar{F} = q\bar{v} \times \bar{B}$$

miðsóknarkraftur $= \frac{mv^2}{r} = qvB$

$F = ma_r$

$$r = \frac{mv}{qB}$$

geislabrautar

tími einnar hringhreyfingar

$$T = \frac{2\pi r}{v} = \frac{2\pi m}{qB}$$

umferð — Lota, lotutími

tíðni hringhreyfingar

$$f_c = \frac{1}{T} = \frac{qB}{2\pi m}$$

eða horntíðni

$$\omega_c = \frac{qB}{m}$$

Hringhraðalstíðni

↳ hraðar, en ekki einungis

Kemur fyrir alstaðar þar sem agnir hreyfast í föstu segulsviði

Úti í geimnum
í peltetni .... tilraunum

Gormlaga hreyfing

"Ögn kemur inn í fast segulsvið (einsleitt) þ.a. $\bar{v}$ er ekki hornrétt á $\bar{B}$

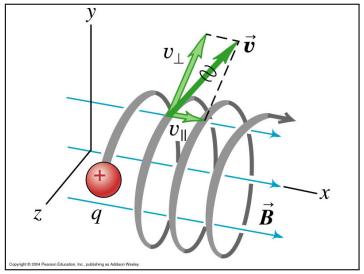
$$\bar{v} = \bar{v}_{\parallel} + \bar{v}_{\perp}$$

$\bar{v}_{\parallel}$: samsíða $\bar{B}$

$\bar{v}_{\perp}$: hornrétt á $\bar{B}$

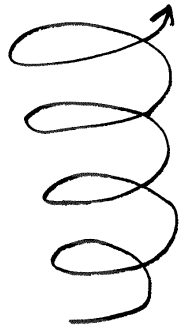
$$\bar{v} \times \bar{B} = \bar{v}_{\parallel} \times \bar{B} + \bar{v}_{\perp} \times \bar{B}$$

$$= 0 + \bar{v}_{\perp} \times \bar{B}$$



→ hringhreyfing með $a_r = -\frac{|q| v_\perp B}{m}$

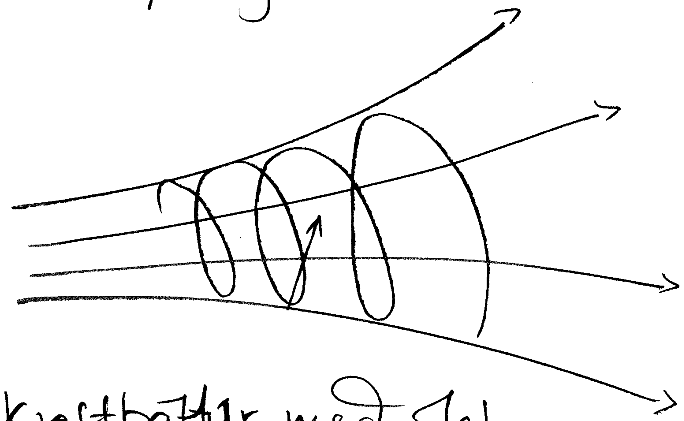
og óbreyttum $\bar{v}_{\parallel}$



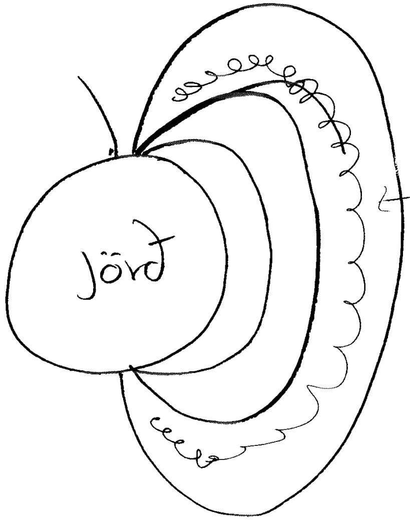
$$d = v_{\parallel} T$$

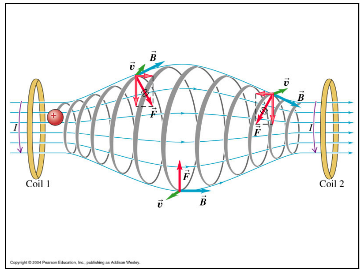
$$= v_{\parallel} \frac{2\pi m}{qB}$$

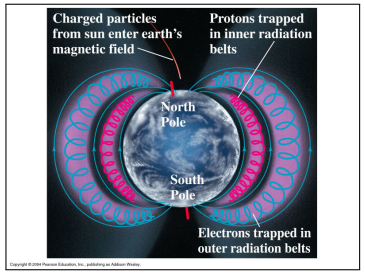
Breytilegt segulsvið



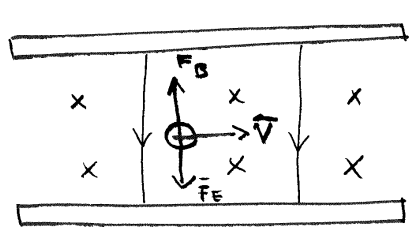
Kraftþáttur með stefnu frá háu sviði til lágs!

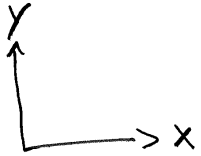






Segul og rafsvið





$$\rightarrow \bar{F} = q\left(\bar{E} + \bar{v} \times \bar{B}\right) = \bar{F}_E + \bar{F}_B$$

↑ Lorentz kraftur

Fyrir hvaða eindir gildir $F = 0$?

$$F = 0 \rightarrow \bar{E} = -\bar{v} \times \bar{B}$$

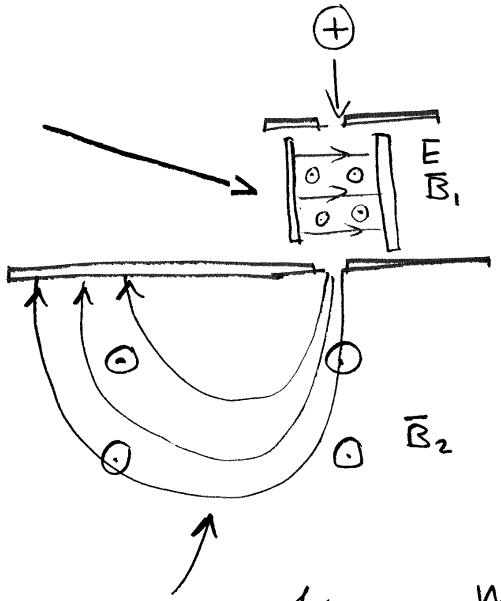
↖ í þessari uppsetningu : $E = vB$

→ eindir með $v = \frac{E}{B}$ fara beina línu

(hægt að velja hraða)

Massagreinir

engin sveigja
$\rightarrow v = \frac{E}{B_1}$



hringgeisli $r = \frac{mv}{qB_2}$

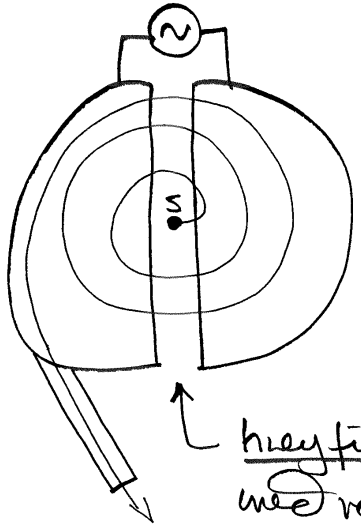
fastur geisli $\leftrightarrow$ fast hlutfall massa og hleðslu

$$\frac{m}{q} = \frac{rB_2}{v} = \frac{B_1 B_2}{E} r$$

r mælt til að finna $\frac{m}{q}$

Hringhraðall

Einda hraðall í föstu þverstæðu segulsviði



fyrir p^+
$E_{max} \sim 25\,MeV$

hreyfiorkan er aukin með rafsviði á milli dæma

$T = \frac{2\pi m}{qB}$ óháð r $\rightarrow$ tíðni $(\nu) = T^{-1}$

örvunargeislun vegna hröðunar $\perp$ radial

Samhraðall

fast r, breytilegt E og B

↳ hröðun

Orkutap —> geislun í púlsum

útfjólublá -> röntgen

-> gamma

notuð til mælinga á þéttefni

samhraðalsgeislun

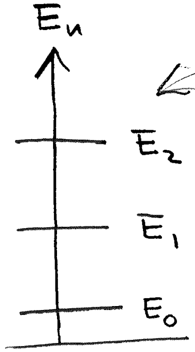
Orkuróf einda á hreyfingu í segulsviði er samfellt

↑ **sígild eðlisfræði**

Skammtafræði

Orkuróf er strjált (Landau stig)

$$E_n = \hbar\omega_c(n + 1/2), \quad n = 0, 1, 2, 3, \ldots$$



margar eindir á hverju stigi

stökk rafeinda milli orkustiga vegna ytri geislunar (ljóseindir)

Hringhraðalsherma

inni í efni

t.d. $\hbar\omega_c \sim 1-10$ meV

$\langle r \rangle \sim 100 - 10$ nm $\quad T = 1K$

geislun ~ fjær innrauða