# POLARISATION

Beskriver vikturingen på ett E-fält.
Alla fält vi ha behandlat hittills:


"Linjär polarisation" ("planpolarisation"

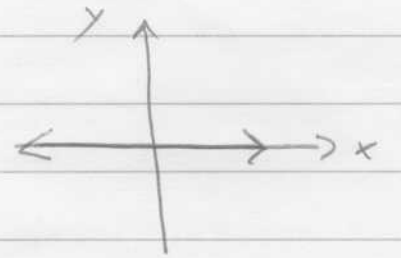
t.ex. $\vec{E} = E_0 \cdot \hat{x} \cdot e^{i(kz-\omega t)}$

En "vanlig" ljuskälla emitterar ljus isolupt, med alla möjliga pol.-komponenter i en oordnad blandning.

$$\left( \vec{E}_{tot} = \sum_{n=1}^{\infty} \vec{E}_{0n} \cdot e^{i(\vec{k}_n \cdot \vec{r} - \omega_n t + \varepsilon_n)} \right)$$

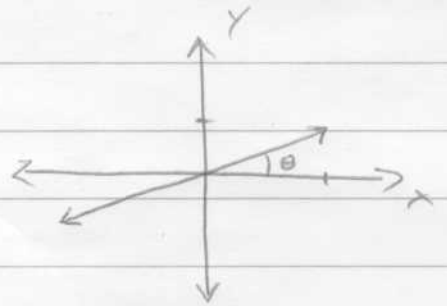
Vanlig grafisk representation:
Ljuset antas propagera ut ur tavlan (längs z-axeln)

Linjär-polarisation (riktad $\hat{x}$)



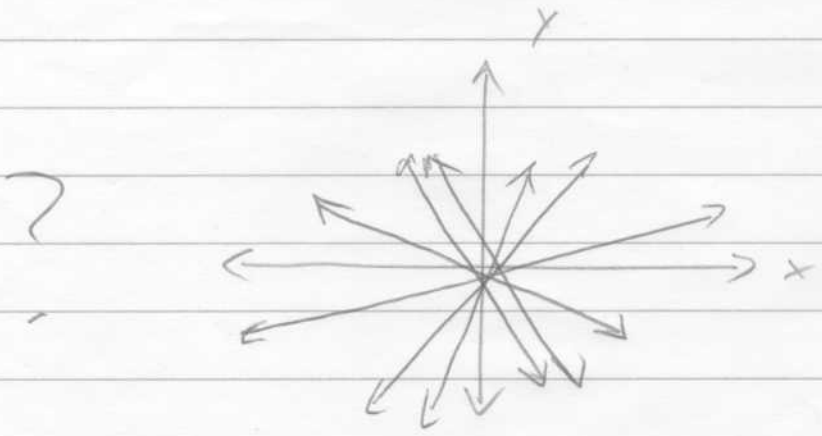

$$\vec{E} = E_0 \cdot \hat{x} \cdot e^{i(kz - \omega t)}$$

Linjär pol i godtycklig riktning ($\theta$)




$$\vec{E} = E_0 \cdot (\hat{x} \cdot \cos\theta + \hat{y} \cdot \sin\theta) \cdot e^{i(kz - \omega t)}$$

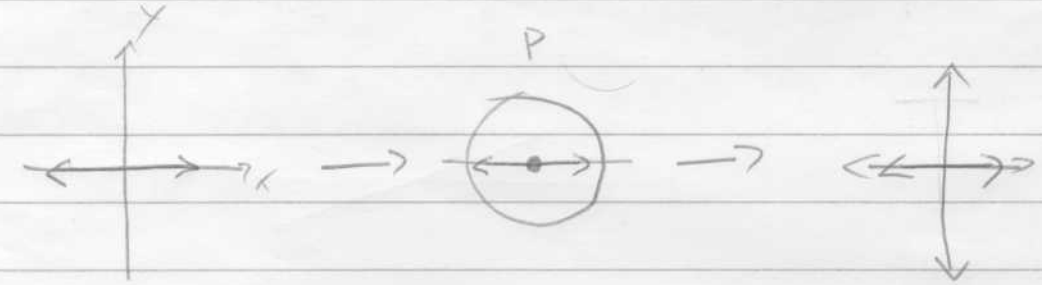
Opolariserat:



# Polarisator

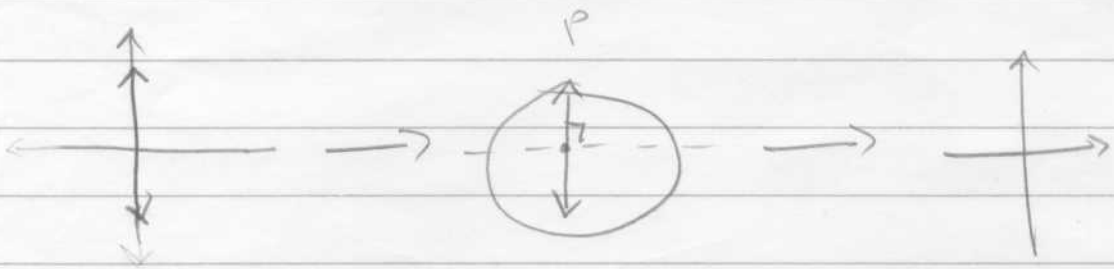
En optisk komponent som absorberar allt ljus med en viss polarisation, + alltmänt kan en polarisator vridas (analysator)

Linjärt pol. // med polarisatorns axel (PA)



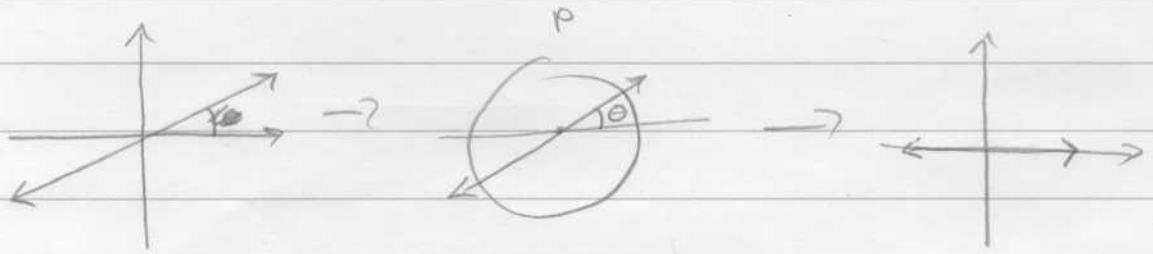

$I_0$ ⟶ $I_1 = I_0$

Linjär pol ⊥ med PA

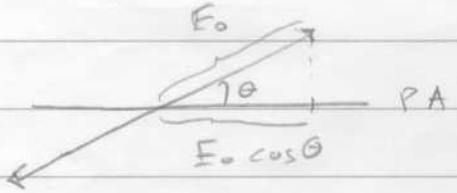



$I_0$ ⟶ $I_1 = 0$

Linj. pol. i vinkel $\theta$ mot PA




$I_0 \longrightarrow I_1 = I_0 \cdot \cos^2\theta$



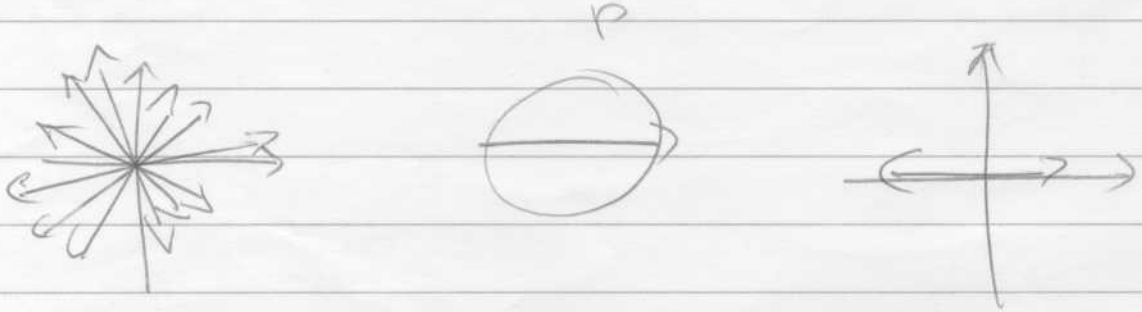

$I \sim E_0^2$

$\Rightarrow I_1 = I_0 \cdot \cos^2\theta$

$I_1 = I_0 \cdot \cos^2\theta$

Malus lag

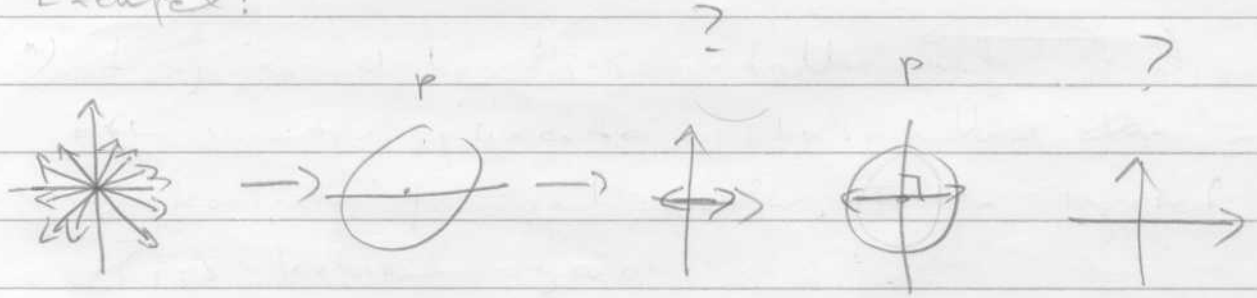
Opol. ljus

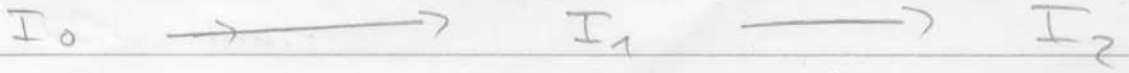



$I_0 \longrightarrow I_1 \quad I_0/2$

$$I_1 = I_0 \cdot \frac{1}{2\pi} \int_0^{2\pi} \cos^2\theta \, d\theta = \frac{I_0}{2}$$

Exempel:

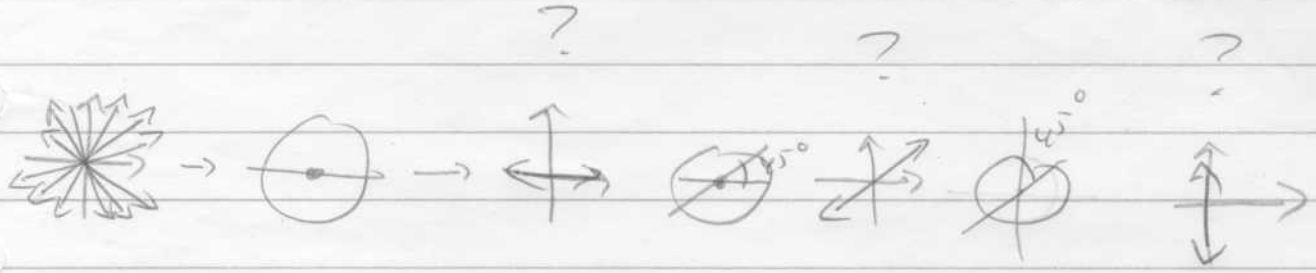



$$I_1 = I_0/2$$

$$I_2 = \frac{I_0}{2} \cdot \cos^2 90 = 0$$

Exempel:




$I_0$ $I_1 = ?$ $I_2 = ?$ $I_3 = ?$

$$I_1 = I_0/2$$

$$I_2 = \frac{I_0}{2} \cdot \cos^2 45^\circ = \frac{I_0}{4}$$

$$I_3 = \frac{I_0}{4} \cdot \cos^2 45^\circ = \frac{I_0}{8}$$

# λ-plattor

(Vågplattor, vetandadiusplattor)

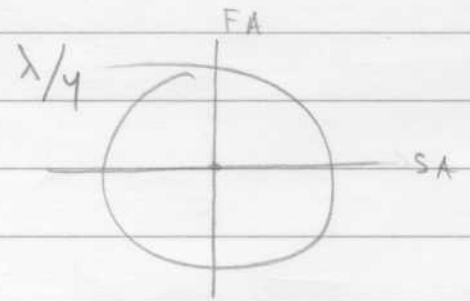
En "platta" där olika E-fältsvinkningar kämna av olika brytningsindex. Alltså propagera ljus med olika polarisation olika fort.

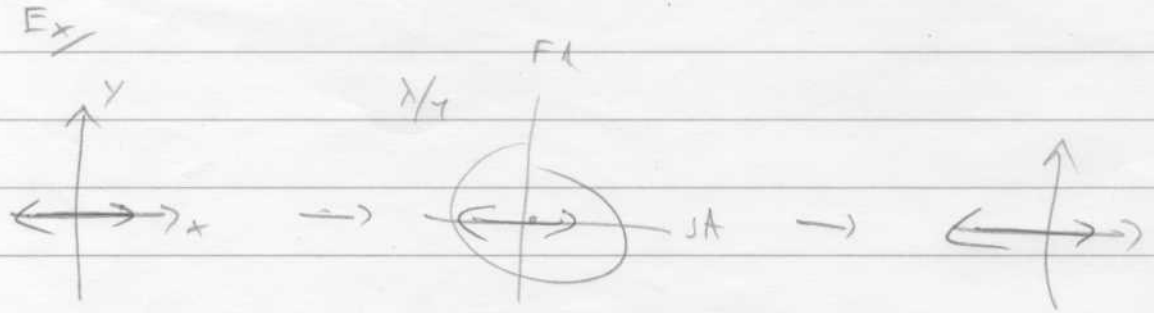
Den axel som ger lägst n ($n_f$): fast axis

——— " ——— högst n ($n_s$): slow axis

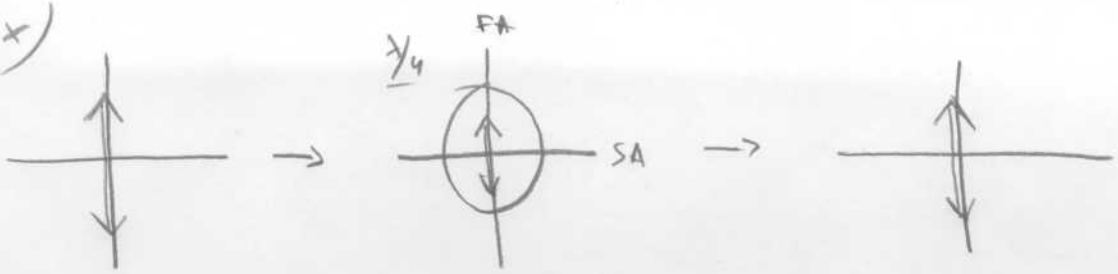
## λ/4-platta (kvartsvågsplatta)

Plattan tjocklek ha anpassats så att ljus pol. längs slow axis ha kommit exakt en kvarts våglängd efter ljus pol. längs F-axis.

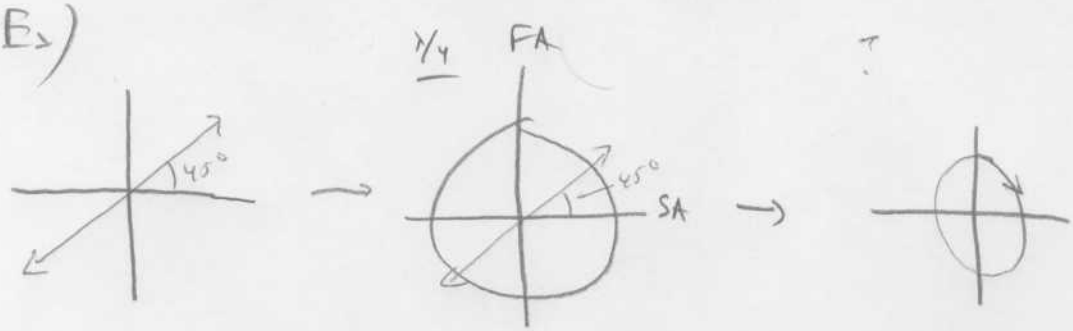


Ex)




Ex)




Infallande pol. kan delas upp i komponenter längs FA och SA

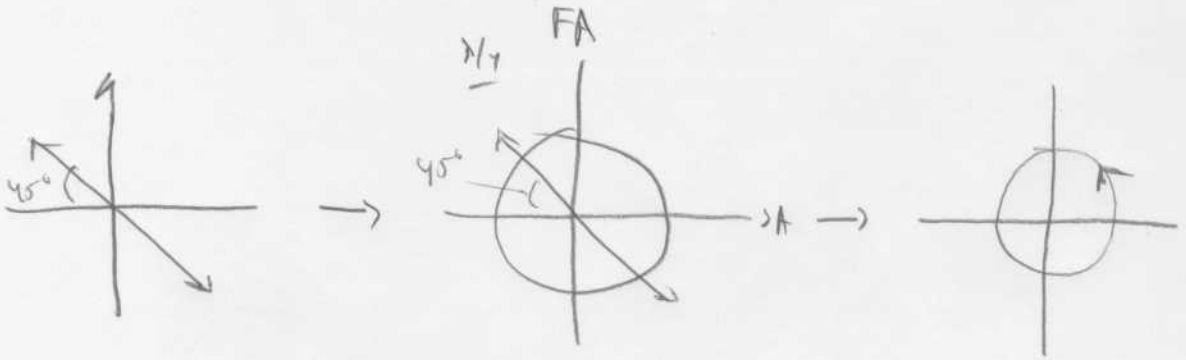
~~OH 11_1~~
OH 9-2

Om nu komponenten längs $\hat{x}$ hamnar en kvarts våglängd efter:

~~OH 11_2~~
OH 9-3

=> höger - cirkulärt polariserat ljus (medurs)

ex)

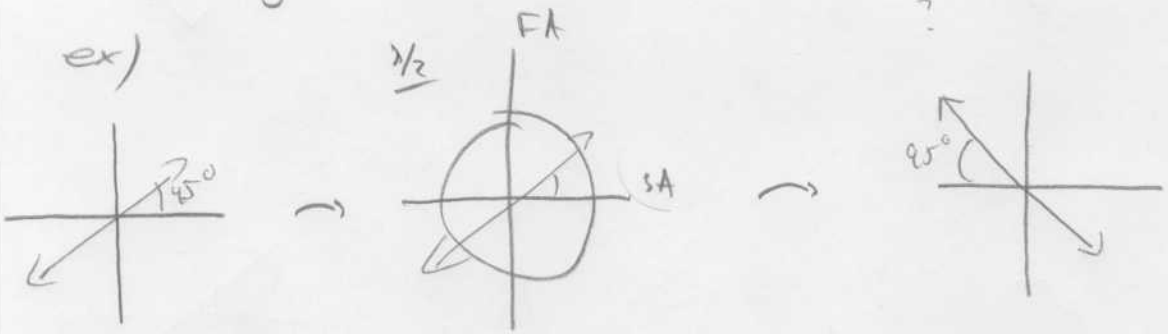



=> Vänster-cirk. pol.

# $\lambda/2$-platta (halvvågsplatta)

Den ena komponenten kommer en halv våglängd efter.

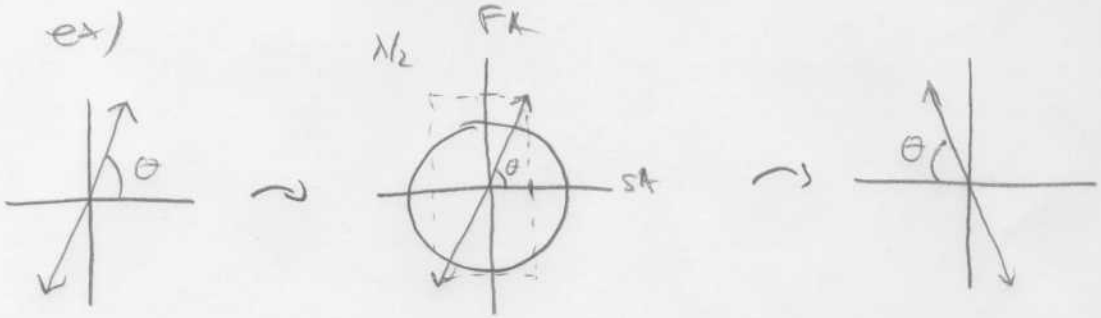
ex)



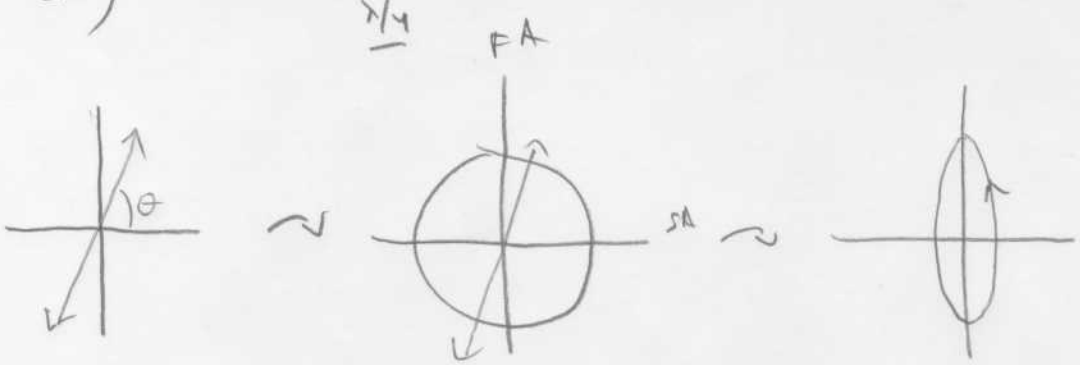

~~OH 11-3~~

OH 9-4

ex)




ex)




"elliptisk pol."

Matematisk vepr. av cirk. pol. ljus.

Allmänt: $\vec{E} = E_x \cdot \hat{x} + E_y \cdot \hat{y}$

Hö:
$$\begin{cases} E_x = E_0 \cdot \sin\left(kz - \omega t + \pi/2\right) = E_0 \cdot \cos\left(kz - \omega t\right) \\ E_y = E_0 \cdot \sin\left(kz - \omega t\right) \end{cases}$$

$$\therefore \vec{E} = E_0 \cdot \left\{ \hat{x} \cdot \cos\left(kz - \omega t\right) + \hat{y} \cdot \sin\left(kz - \omega t\right) \right\}$$

pss Vä:
$$\vec{E} = E_0 \cdot \left\{ \hat{x} \cdot \sin\left(kz - \omega t\right) + \hat{y} \cdot \cos\left(kz - \omega t\right) \right\}$$

Superpos. av Hö cirk. pol- och Vä. cirk. pol-ljus:

$$E_{TOT} = E_0 \cdot \left\{ \hat{x} \cdot \left(\cos(\,) + \sin(\,)\right) + \hat{y} \left(\sin(\,) + \cos(\,)\right) \right\}$$

$\Rightarrow$ linj. pol !!