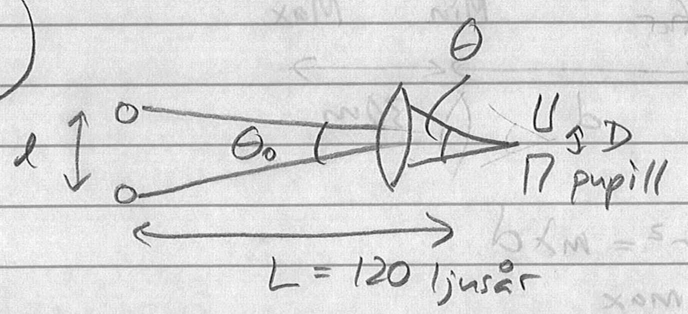
Lösningar tenta 080317

(1)



Rayleighs upplösningskriterium

$$\theta = \frac{1{,}22\,\lambda}{D}$$

Vinkelförstoring $\theta = 20\theta_0$

$$\theta_0 = \frac{l}{L}$$

$$\Rightarrow l = L\theta_0 = \frac{L}{20}\theta = \frac{1{,}22 L\lambda}{20D}$$

Om man tar $D = 3$ mm: $l = 1{,}2\cdot 10^{-3}$ ljusår

$\lambda = 500$ nm: $= \underline{\underline{1{,}2\cdot 10^{13}\ m}}$

(2) Koherenstid $\tau = 300\cdot 10^{-18}$ s

$\Rightarrow$ koherenslängd (temporal) $l_t = c\tau$

Kriterium: $\Lambda \leq l_t$ ger god visibilitet

Frans: $\Lambda = m\lambda$

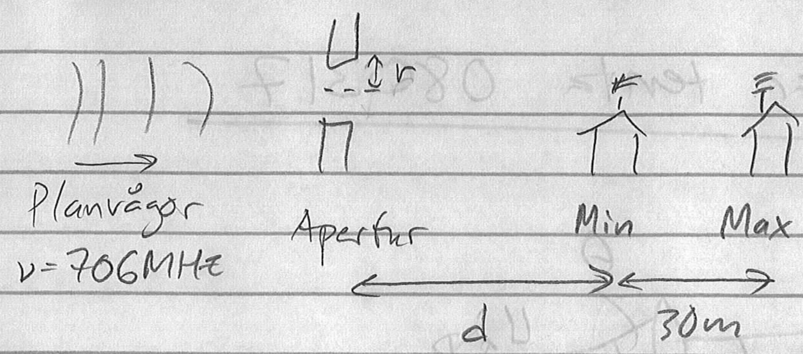
Sätt $m\lambda = l_t \Rightarrow m = \frac{l_t}{\lambda}$

Tag $\lambda = 10^{-9}$ m för XUV-strålar

$$m = \frac{l_t}{\lambda} = \underline{\underline{90}}$$ $\therefore$ Antal franser $= 2m = \underline{\underline{180}}$ st

$\approx \underline{\underline{200\ st}}$

(3)



Fresneldiffraktion $r^2 = m\lambda d$

$m = 1, 3, 5 \ldots \Rightarrow$ max

$2, 4, 6 \ldots$ min

Tag $m=2$ för avstånd d granne

$m=1$ för avstånd $d+30m$ jag

$$r^2 = 2\lambda d = 1 \cdot \lambda (d + 30m)$$

$$\Rightarrow \underline{d = 30\ m}$$

$$r = \sqrt{2\lambda \cdot 30m} = \sqrt{2 \cdot \frac{c}{\nu} \cdot 30m} = \sqrt{25{,}4m^2} = \underline{5{,}0m}$$

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b) Reflektioner från föremål i omgivningen

Ändlig storlek på plattan

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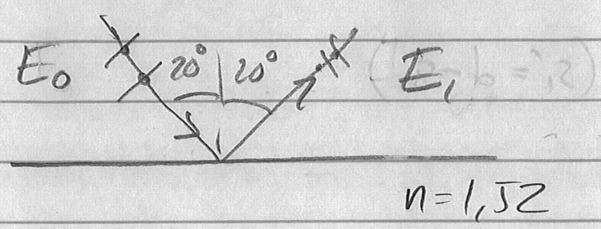
(4) Nio fransar synliga: Frans $m=5$ är dold

Interferensmax $d \sin\theta = 5\lambda$

Diffraktionsmin $b \sin\theta = 1 \cdot \lambda$

$$\Rightarrow b = \frac{d}{5} = \frac{0{,}50mm}{5} = \underline{0{,}10\ mm}$$

(5)



Reflekterad stråle: polariserad 45°

$\longrightarrow E_{1\perp} = E_{1p}$ Finn $E_{0\perp}, E_{0p}$

$E_{1\perp} = R_\perp E_{0\perp}$

$$R_\perp = -\frac{\sin(\theta_i - \theta_t)}{\sin(\theta_i + \theta_t)} = \left\{ \text{Snell } \theta_t = \arcsin\left(\frac{\sin 20^\circ}{1{,}52}\right) = 13{,}00^\circ \right\}$$

$$= -0{,}2236$$

$E_{1p} = R_p E_{0p}$

$$R_p = -\frac{\tan(\theta_i - \theta_t)}{\tan(\theta_i + \theta_t)} = -0{,}1889$$

Polarisation hos infallande

$$\alpha_{pol} = \arctan\frac{E_{0p}}{E_{0\perp}} = \arctan\frac{R_\perp}{R_p} = \underline{\underline{50^\circ}}$$

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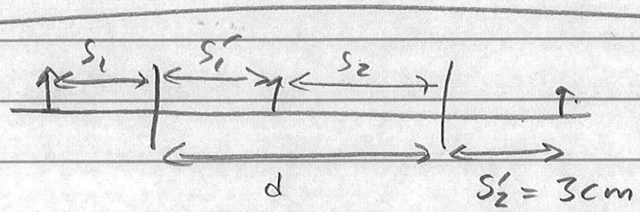
(6)



$f_1 = f_2 = f = 2cm$

Villkor: förstoring $m = \frac{2cm}{5cm}$

Men $m = m_1 m_2 = \left(-\frac{s_2'}{s_2}\right)\left(-\frac{s_1'}{s_1}\right) = \frac{s_1' s_2'}{s_1 s_2} = \frac{2}{5}$

Gauss linsformel

$$s_2 = \frac{1}{1/f - 1/s_2'} = \frac{1}{1/2 - 1/3} \text{ cm} = \underline{6 \text{ cm}}$$

Gauss för lins 1 $(s_1' = d - s_2)$

$$\frac{1}{s_1} = \frac{1}{f} - \frac{1}{s_1'}$$

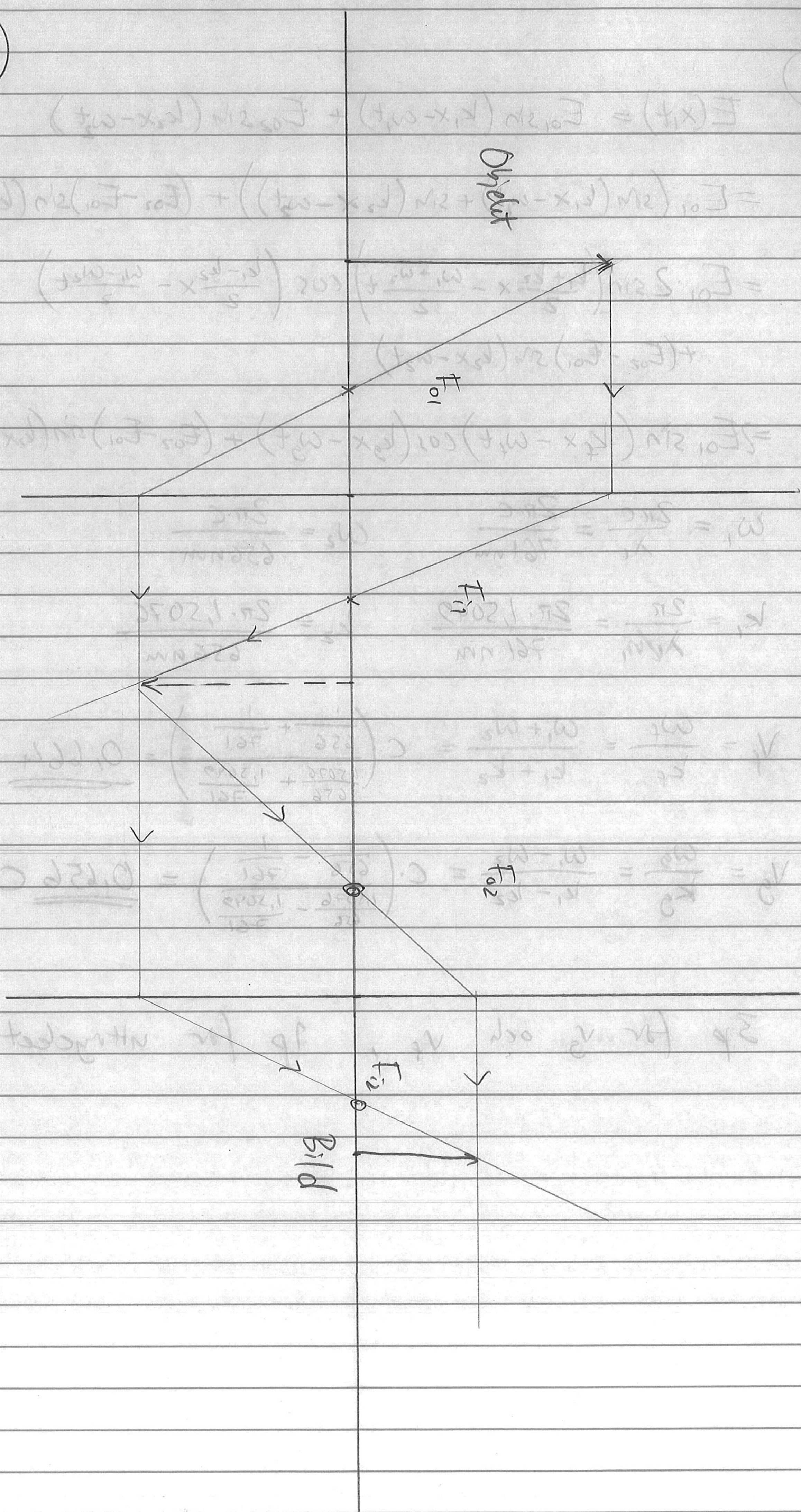
Förstoring $\frac{2}{5} = \frac{s_1' s_2'}{s_1 s_2} = \frac{3}{6} \cdot \frac{s_1'}{s_1}$

$$\frac{4}{5} = \frac{s_1'}{f} - 1 \Rightarrow s_1' = f\left(1 + \frac{4}{5}\right) = \underline{3{,}6 \text{ cm}}$$

$$\Rightarrow s_1 = \frac{1}{1/2 - 1/3{,}6} \text{ cm} = \underline{\underline{4{,}5 \text{ cm}}}$$

$$d = s_1' + s_2 = \underline{\underline{9{,}6 \text{ cm}}}$$

66



(7)

$$E(x,t) = E_{01}\sin(k_1x-\omega_1t) + E_{02}\sin(k_2x-\omega_2t)$$

$$= E_{01}\left(\sin(k_1x-\omega_1t)+\sin(k_2x-\omega_2t)\right) + (E_{02}-E_{01})\sin(k_2x-\omega_2t)$$

$$= E_{01}\cdot 2\sin\left(\frac{k_1+k_2}{2}x - \frac{\omega_1+\omega_2}{2}t\right)\cos\left(\frac{k_1-k_2}{2}x - \frac{\omega_1-\omega_2}{2}t\right)$$

$$+(E_{02}-E_{01})\sin(k_2x-\omega_2t)$$

$$= 2E_{01}\sin(k_fx-\omega_ft)\cos(k_gx-\omega_gt) + (E_{02}-E_{01})\sin(k_2x-\omega_2t)$$

$$\omega_1 = \frac{2\pi c}{\lambda_1} = \frac{2\pi\cdot c}{761\,nm} \qquad \omega_2 = \frac{2\pi\cdot c}{656\,nm}$$

$$k_1 = \frac{2\pi}{\lambda_1/n_1} = \frac{2\pi\cdot 1{,}5049}{761\,nm} \qquad k_2 = \frac{2\pi\cdot 1{,}5076}{656\,nm}$$

$$v_f = \frac{\omega_f}{k_f} = \frac{\omega_1+\omega_2}{k_1+k_2} = c\left(\frac{\frac{1}{656}+\frac{1}{761}}{\frac{1{,}5076}{656}+\frac{1{,}5049}{761}}\right) = \underline{\underline{0{,}664\,c}}$$

$$v_g = \frac{\omega_g}{k_g} = \frac{\omega_1-\omega_2}{k_1-k_2} = c\cdot\left(\frac{\frac{1}{656}-\frac{1}{761}}{\frac{1{,}5076}{656}-\frac{1{,}5049}{761}}\right) = \underline{\underline{0{,}656\,c}}$$

3p för v_g och v_f, 1p för uttrycket