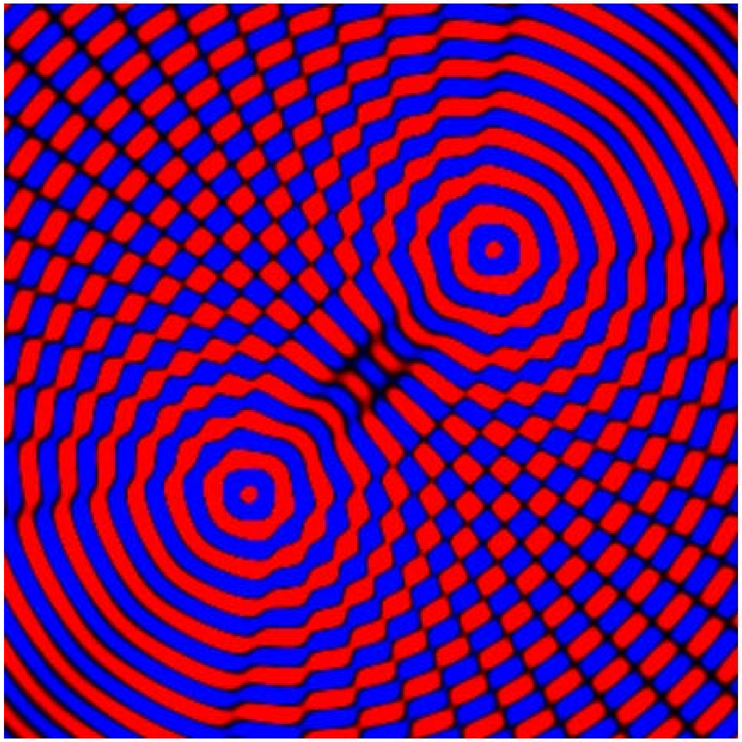
24. Wellen & Optik

18. Jan. 2019

Interferenz zweier Oberflächenwellen



$A_1 =$	0.1	[cm²]	$A_2 =$	0.1	[cm²]
$x_1 =$	2	[cm]	$x_2 =$	4	[cm]
$y_1 =$	2	[cm]	$y_2 =$	4	[cm]
$\phi_1 =$	0	[rad]	$\phi_2 =$	0	[rad]
$\lambda =$	0.3	[cm]	$T =$	0.5	[s]

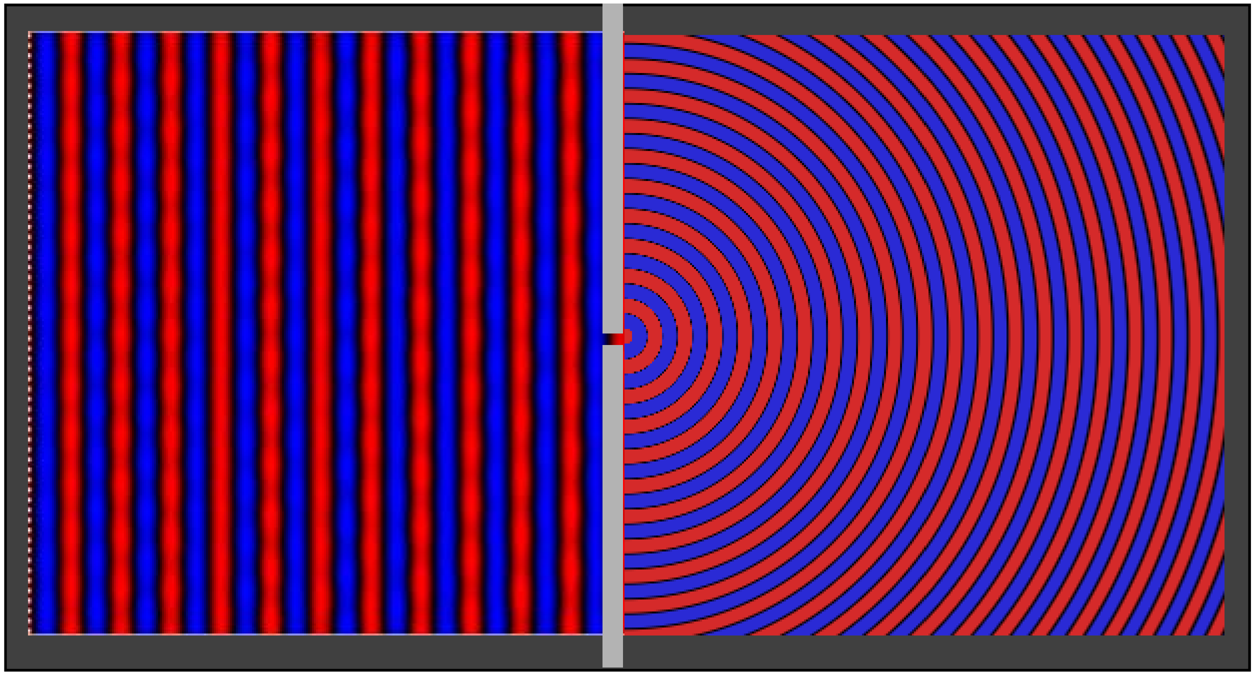
plot at $t =$ 0 [s].

t - T/10 t + T/10

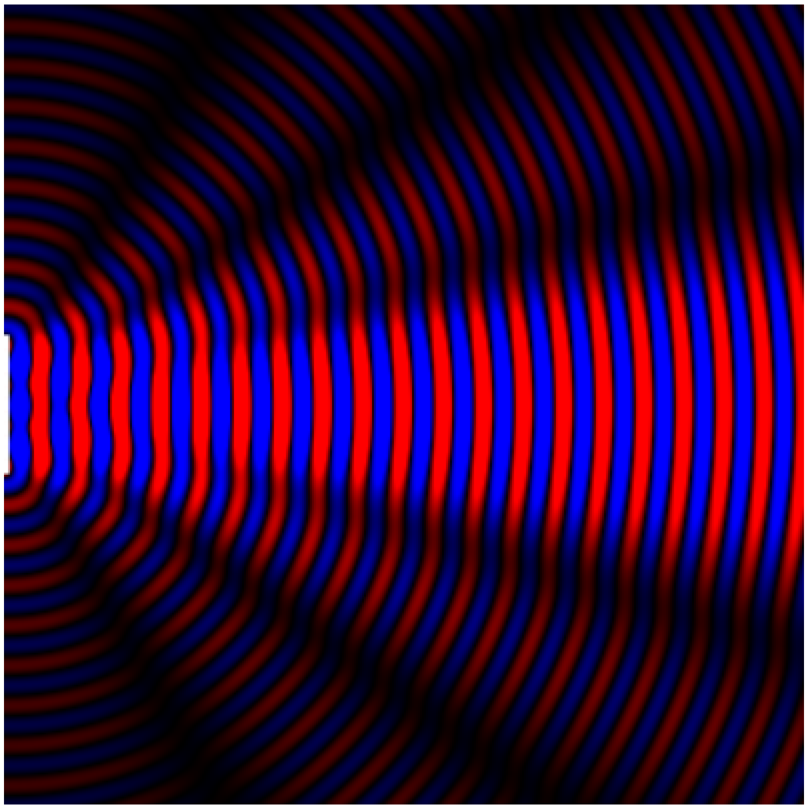
$$c = \frac{\lambda}{T}$$

$$z(r,t) = \frac{A_1}{\sqrt{|r-r_1|}}\cos\left(k|r-r_1| - \omega t + \varphi_1\right) + \frac{A_2}{\sqrt{|r-r_2|}}\cos\left(k|r-r_2| - \omega t + \varphi_2\right)$$

Huygenssches Prinzip



Einfachspalt



$N =$ 40

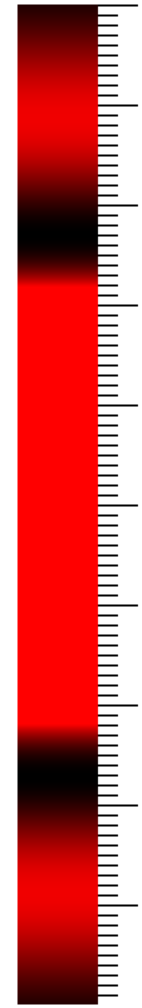
$\lambda =$ 0.3 [cm]

$a =$ 1 [cm]

$T =$ 0.5 [s]

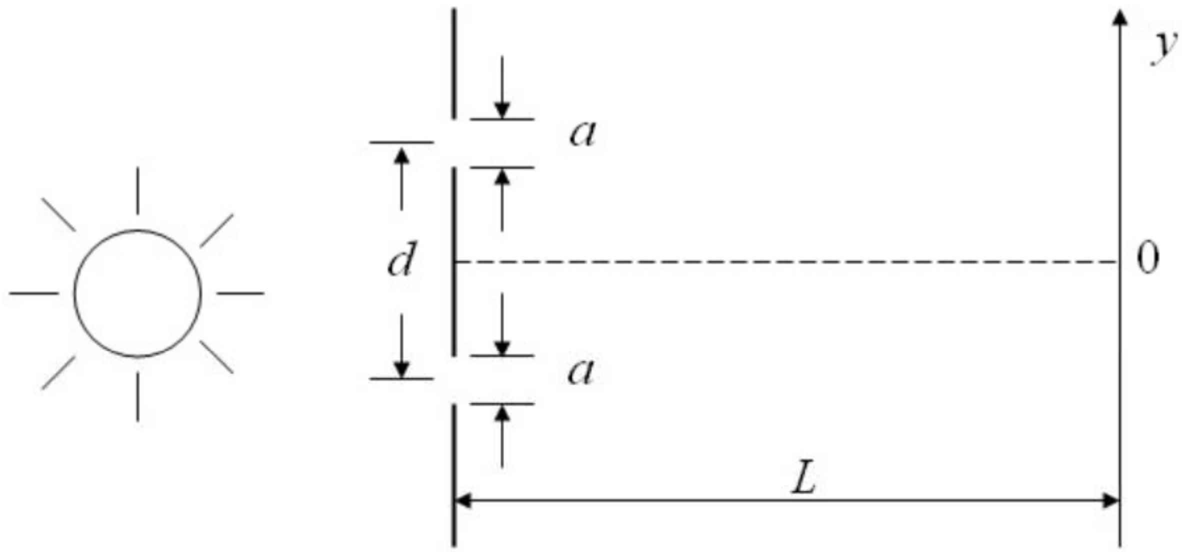
plot bei $t =$ 0 [s].

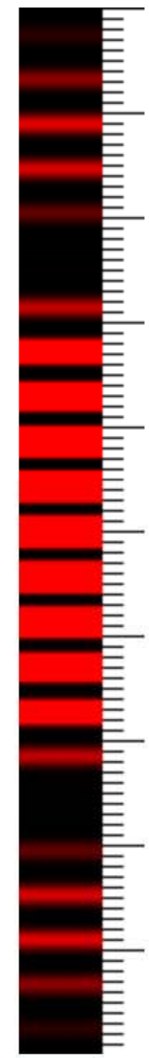
t - T/10 t + T/10



Beugung an zwei Einfachspalten der Breite *a*

Licht fällt auf zwei Spalten der Breite a, deren Mittelpunkte den Abstand d haben. Ein Interferenzmuster wird auf einem im Abstand L von den Spalten stehenden Schirm beobachtet. Das Doppelspaltinterferenzmuster für schmale Spalten wird mit dem Muster des Einfachspalts moduliert.





$a =$ 5E-5 [m]

$d =$ 3E-4 [m]

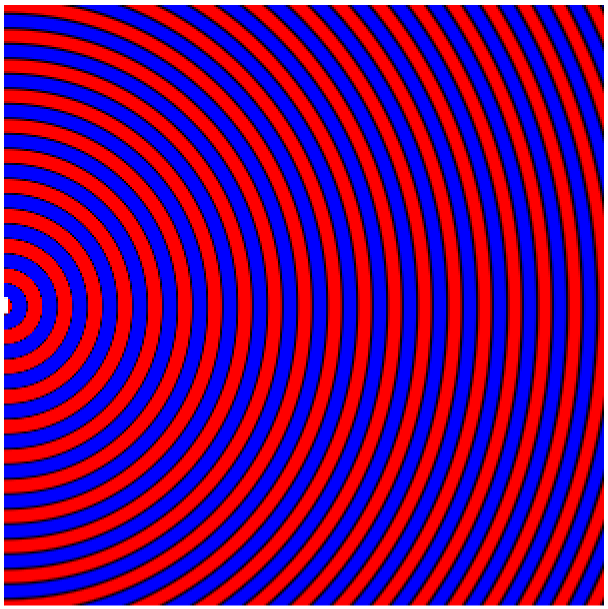
$L =$ 2 [m]

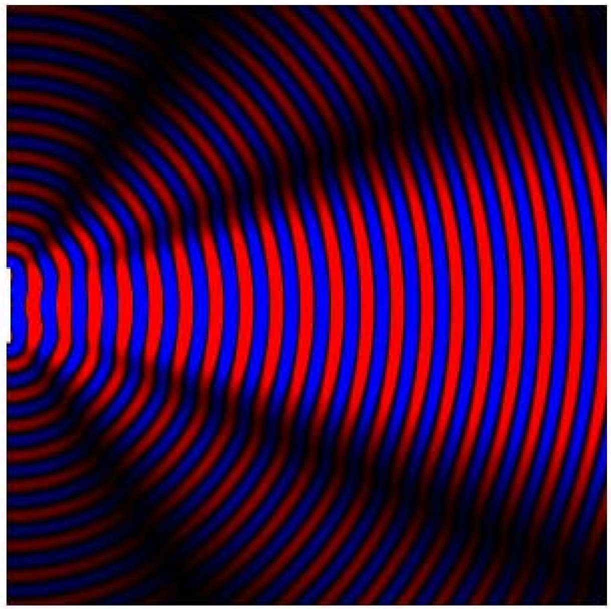
$\lambda =$ 650 [nm]

plot

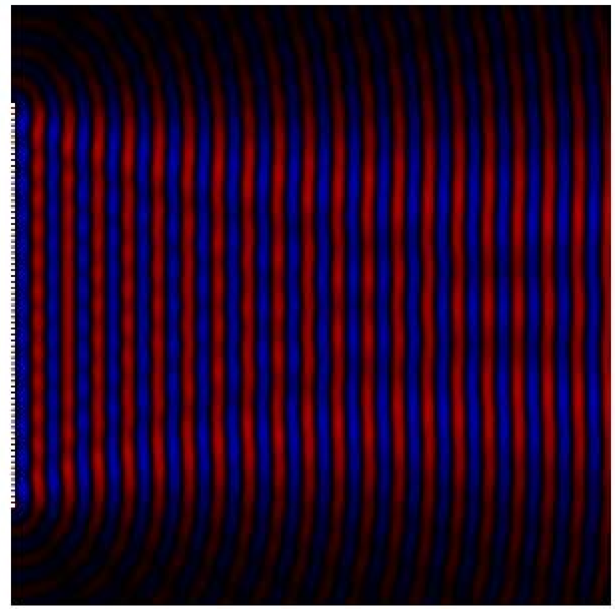
Die kleine Teilung des rechten Maßstabes ist in mm.

Wellen / Optik



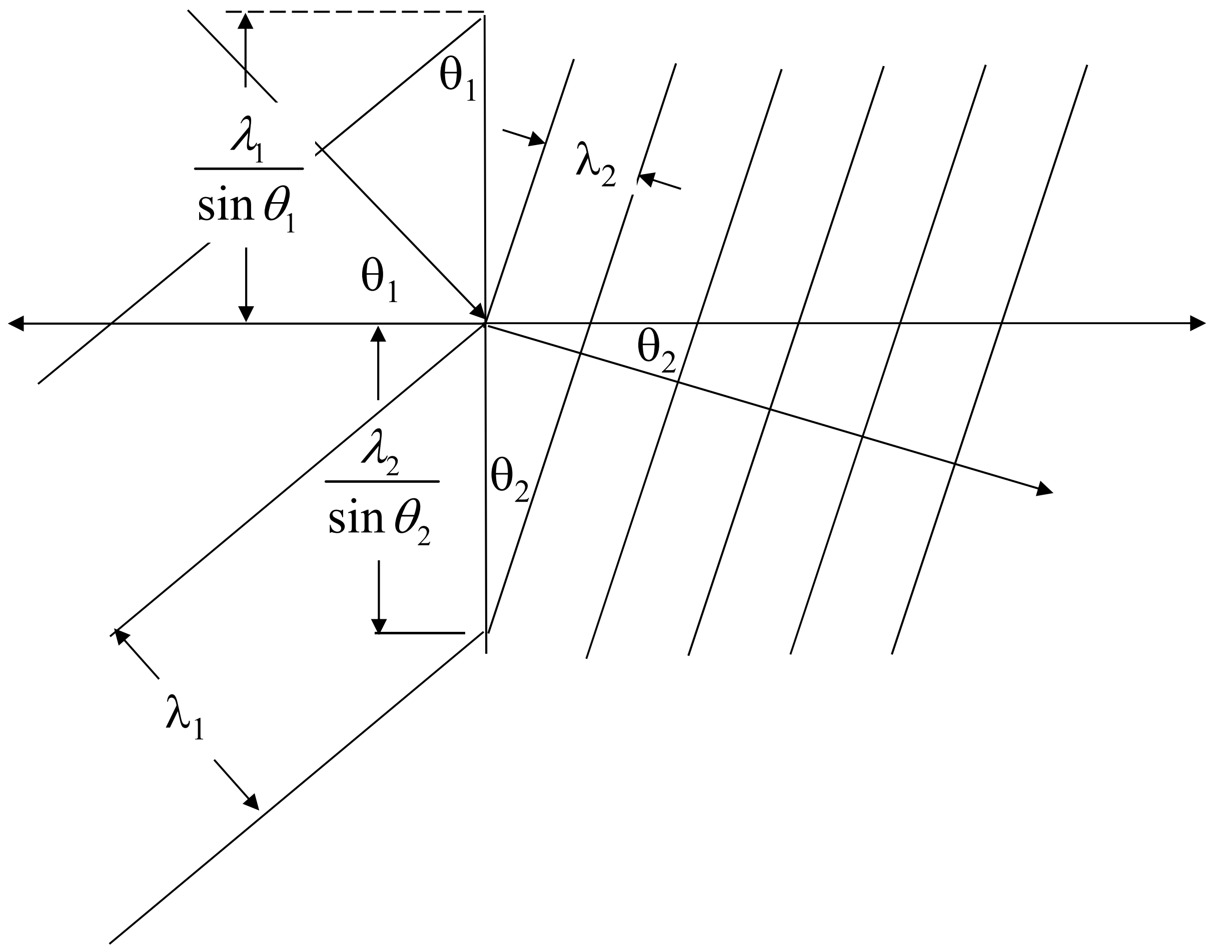


Wellenoptik: $L \sim \lambda$



Geometrische Optik: $L >> \lambda$

Snelliussches Brechungsgesetz

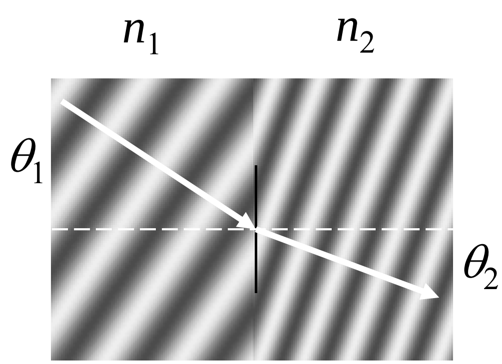


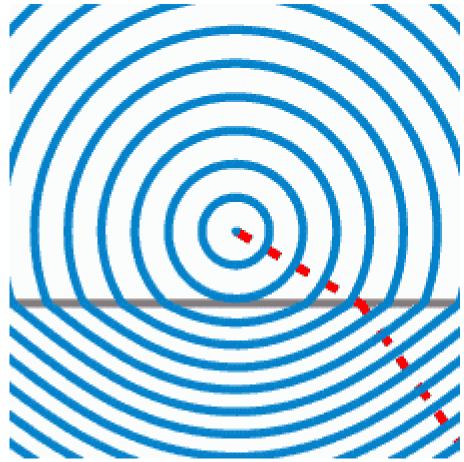
$$\frac{\lambda_1}{\sin\theta_1} = \frac{\lambda_2}{\sin\theta_2}$$

$$\lambda_1 = \frac{c_1}{f} \qquad \lambda_2 = \frac{c_2}{f}$$

$$\boxed{\frac{c_1}{\sin\theta_1} = \frac{c_2}{\sin\theta_2}}$$

Snelliussches Brechungsgesetz





$$\frac{\lambda_1}{\sin\theta_1} = \frac{\lambda_2}{\sin\theta_2}$$

$$\lambda_1 = \frac{c}{n_1 f} \qquad \lambda_2 = \frac{c}{n_2 f}$$

Brechungsindex

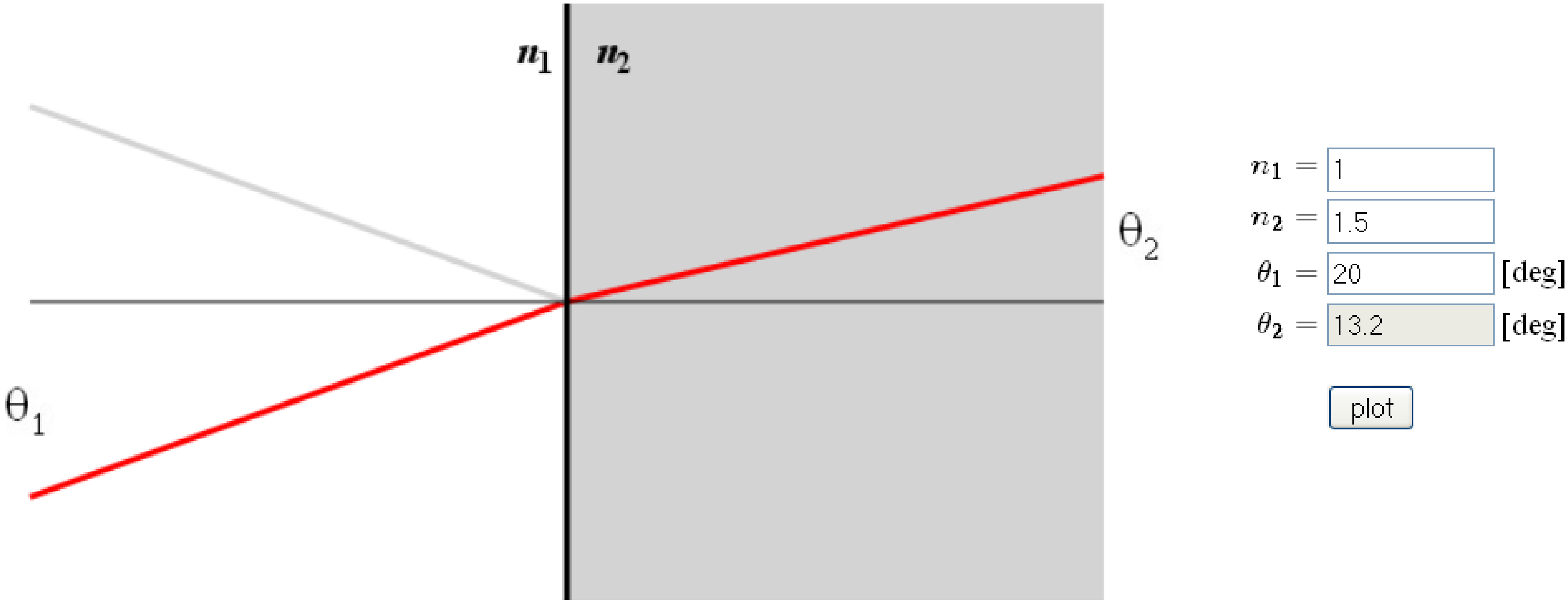
$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

http://commons.wikimedia.org/wiki/File:Wave_refraction.gif

http://commons.wikimedia.org/wiki/File:Snells_law_wavefronts.gif

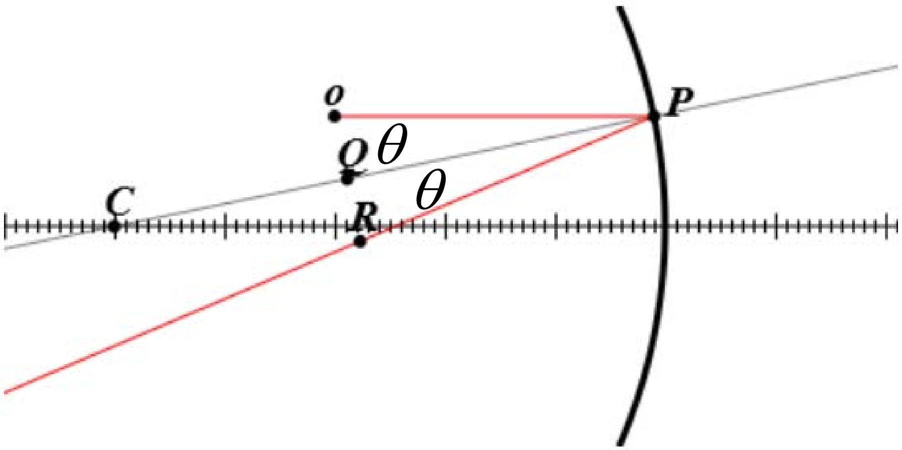
Brechung

$$n_1 \sin\theta_1 = n_2 \sin\theta_2.$$

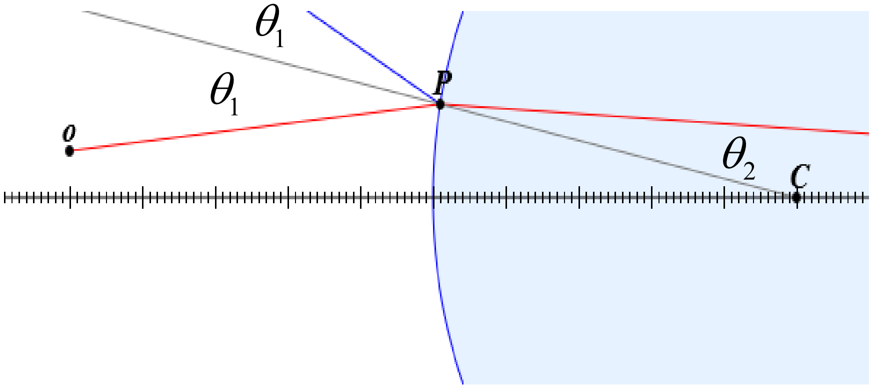


Geometrische Optik

Spiegel:
Einfallswinkel = Reflexionswinkel



Linsen:
Snelliussches Brechungsgesetz



$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

Wellenoptik: $L \sim \lambda$
Geometrische Optik: $L >> \lambda$

Reflection from a curved mirror (1)

$R =$ -5 [cm]

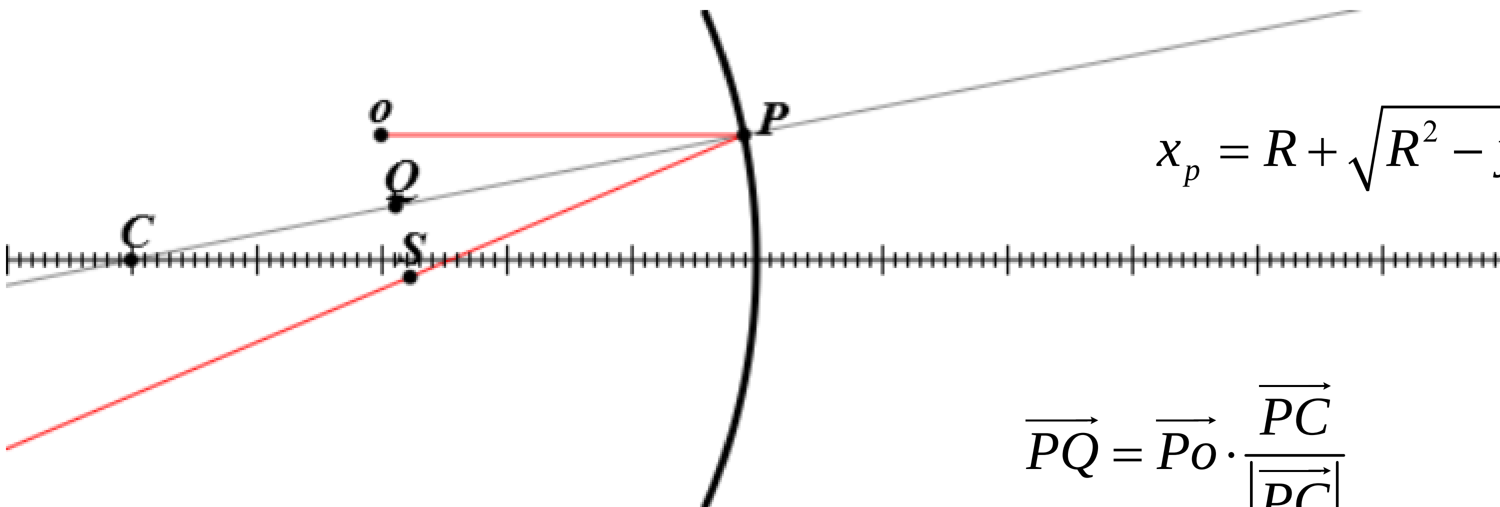
$x_o =$ -3 [cm]

$y_o =$ 1 [cm]

$y_P =$ 1 [cm]

$x_P =$ -0.1010 [cm]

plot



$$x_p = R + \sqrt{R^2 - y_p^2}$$

$$\overrightarrow{PQ} = \overrightarrow{Po} \cdot \frac{\overrightarrow{PC}}{\left|\overrightarrow{PC}\right|}$$

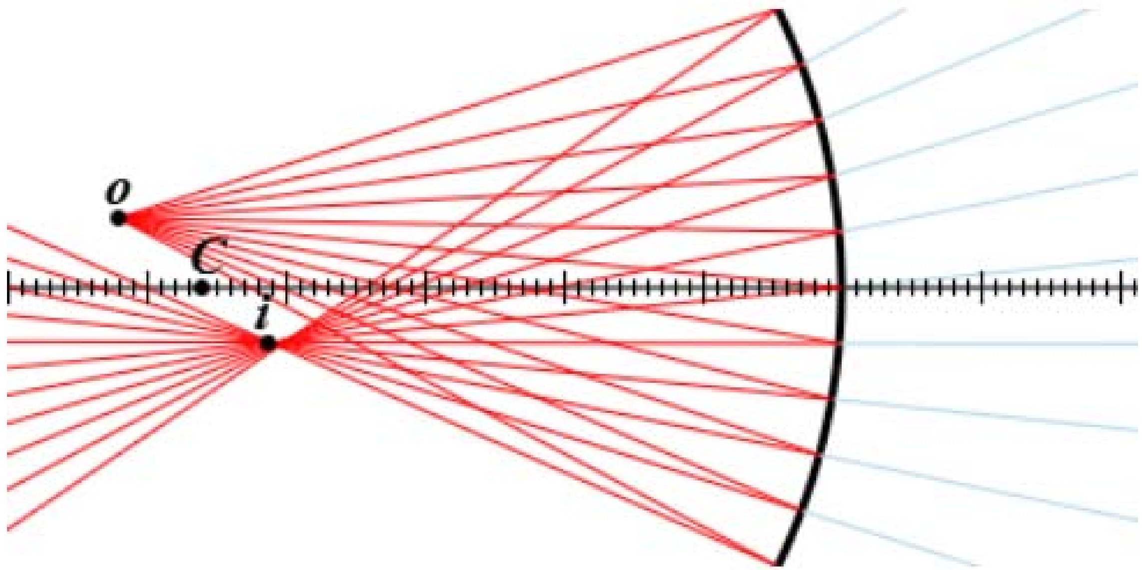
$$\overrightarrow{Po} = \overrightarrow{PQ} + \overrightarrow{Qo}$$

$$\overrightarrow{Ps} = \overrightarrow{PQ} - \overrightarrow{Qo}$$

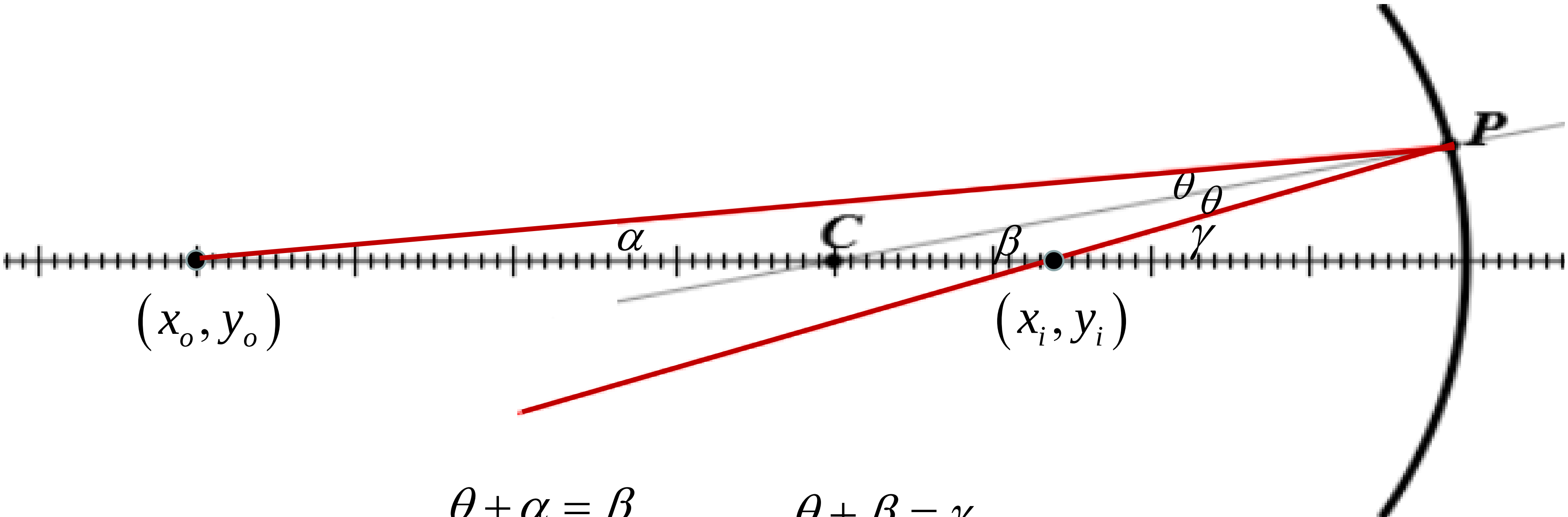
$$\overrightarrow{Po} = (x_o - x_p)\hat{x} + (y_o - y_p)\hat{y}$$

$$\overrightarrow{PC} = (x_C - x_p)\hat{x} + (0 - y_p)\hat{y}$$

Konkavspiegel



Konkavspiegel (kleinen Winkeln)



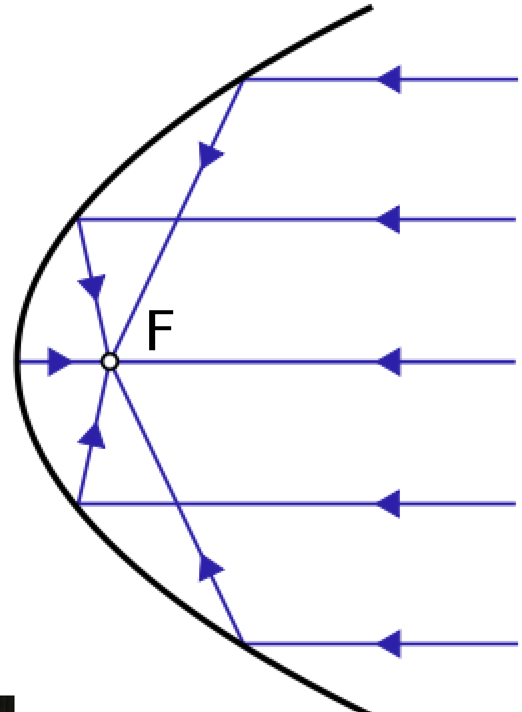
$$\theta + \alpha = \beta \qquad \theta + \beta = \gamma$$

$$\theta = \beta - \alpha = \gamma - \beta$$

$$\alpha \approx \frac{y_p}{x_o} \qquad \beta \approx \frac{y_p}{R} \qquad \gamma \approx \frac{y_p}{x_i}$$

$$\boxed{\frac{1}{x_0} + \frac{1}{x_i} = \frac{2}{R}}$$

Parabolspiegel

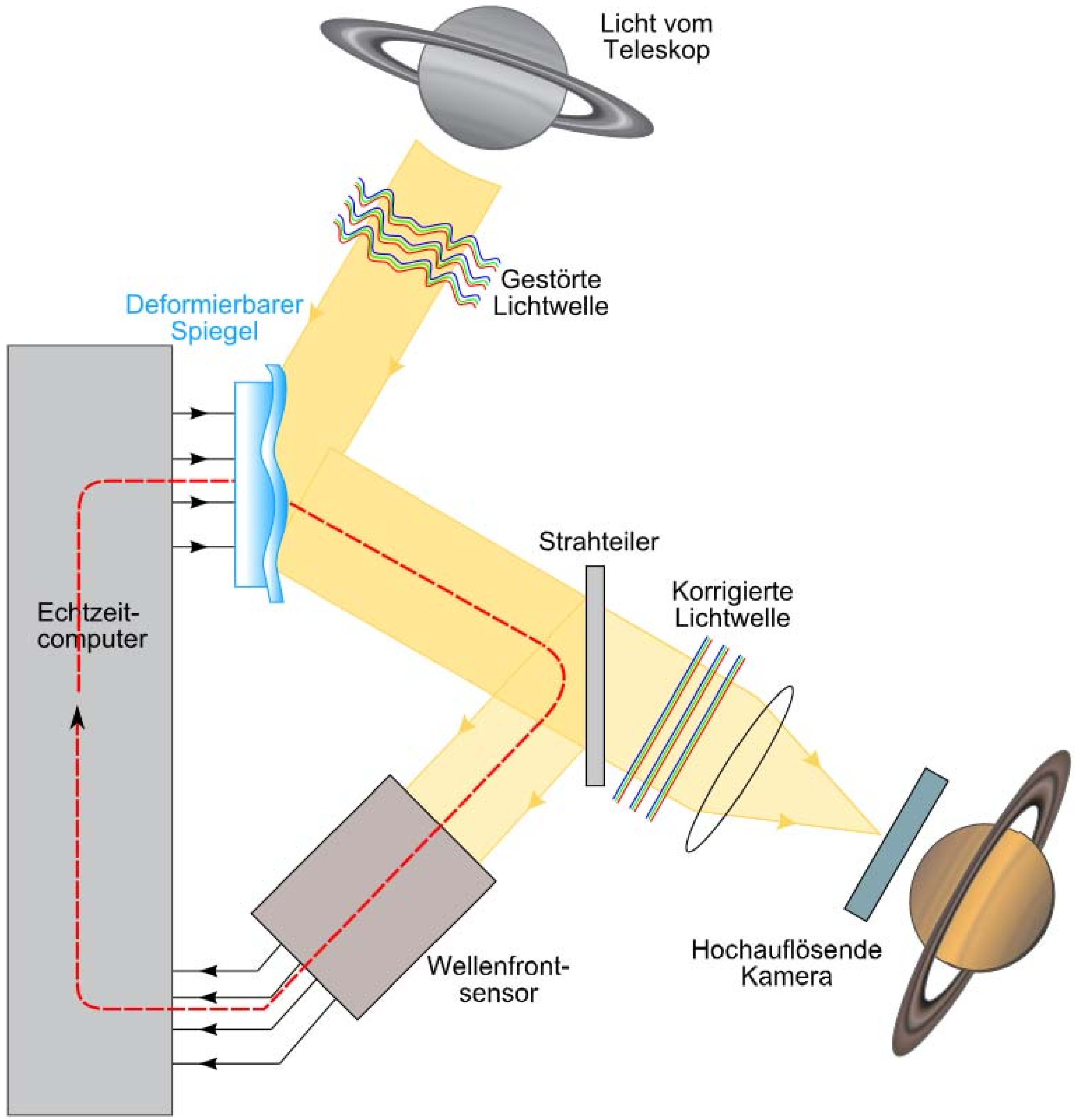


http://commons.wikimedia.org/wiki/File:Radio_telescope_The_Dish.jpg

http://commons.wikimedia.org/wiki/File:Parabolic_mirror-diagram.svg

https://capitalgdenz.wordpress.com/2012/03/12/forehead-focus/

Adaptive Optik



http://upload.wikimedia.org/wikipedia/de/a/ad/AO_Prinzip_MPIA.svg