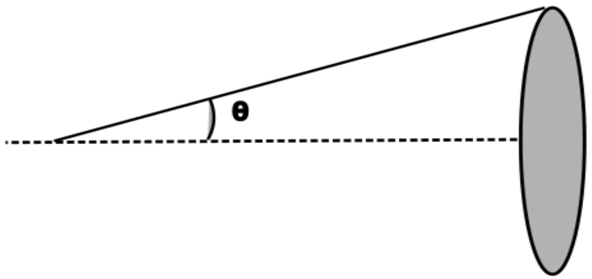
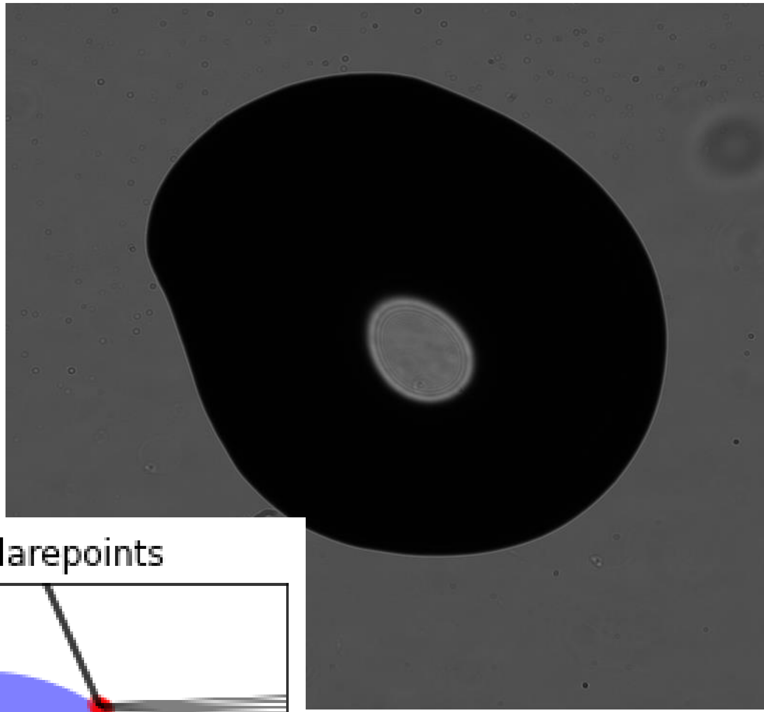
Calculation of droplet glare points

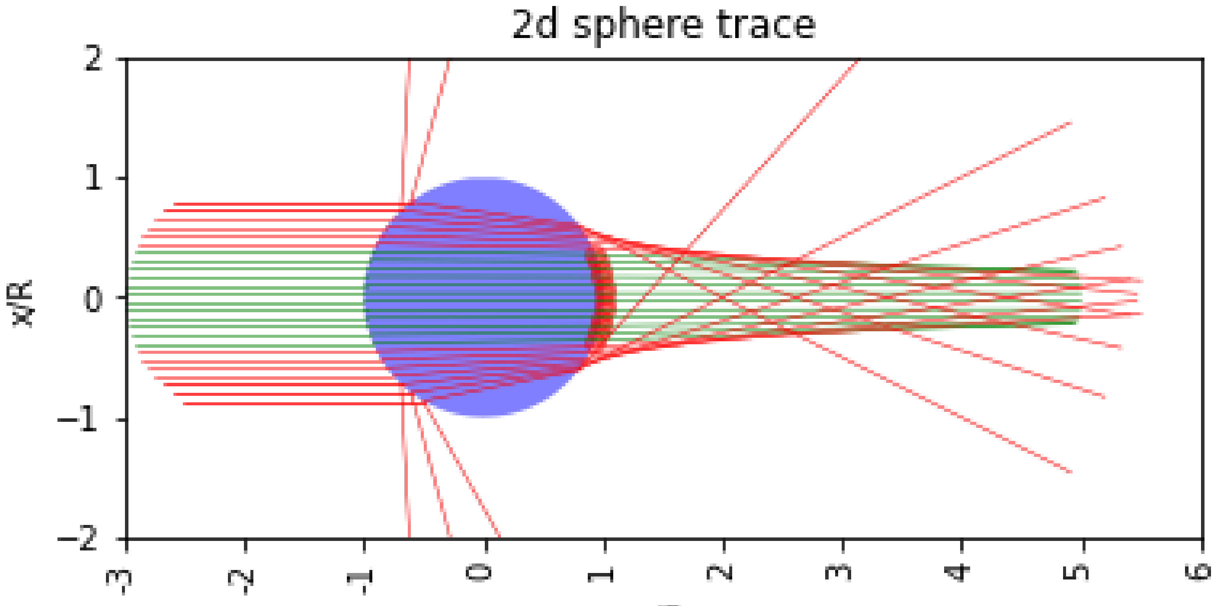
Intensity maxima when a liquid droplet is illuminated and viewed from a certain direction.

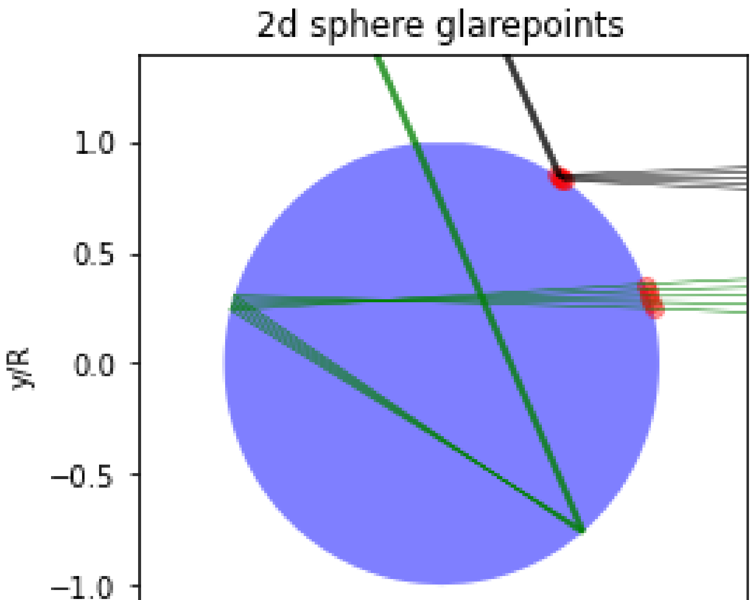
Glare points are then the exit points of the rays.



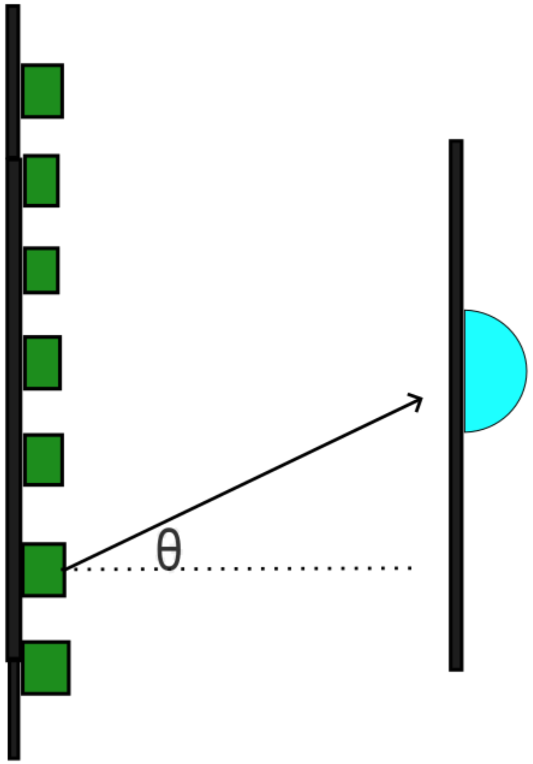


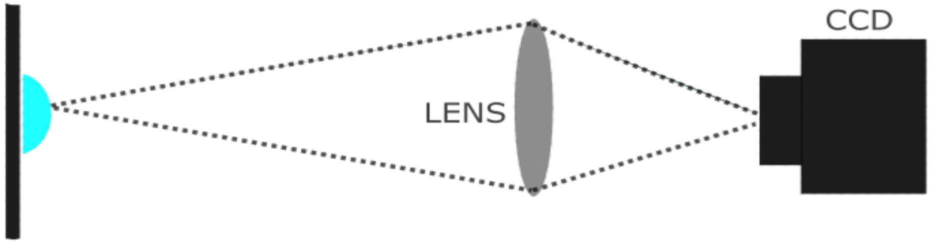
The NA of the objective defines accept angle of the exiting rays.
NA = n $\sin\theta_{max}$

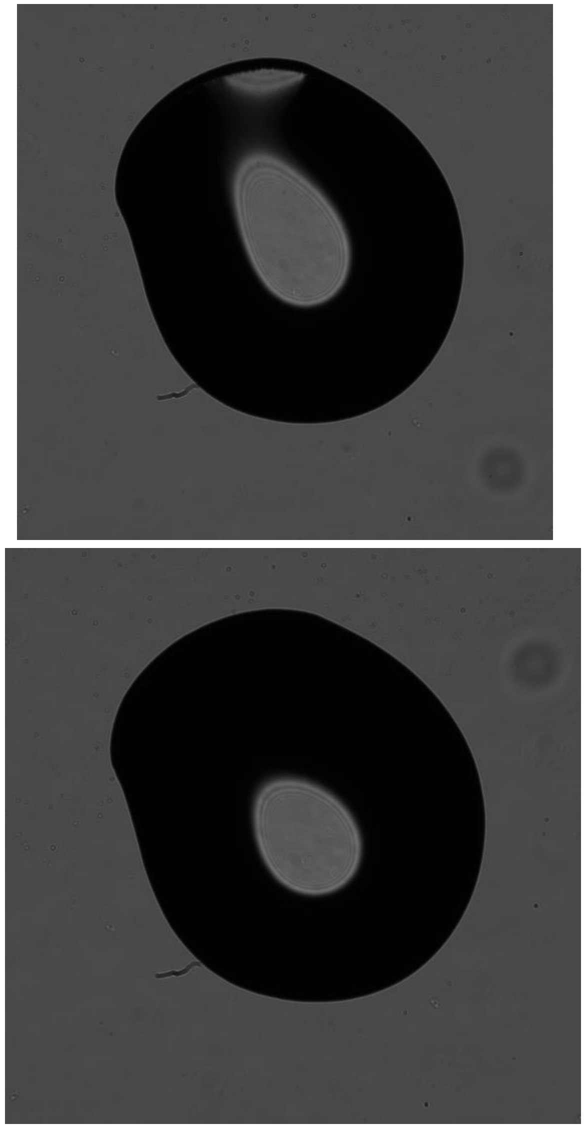


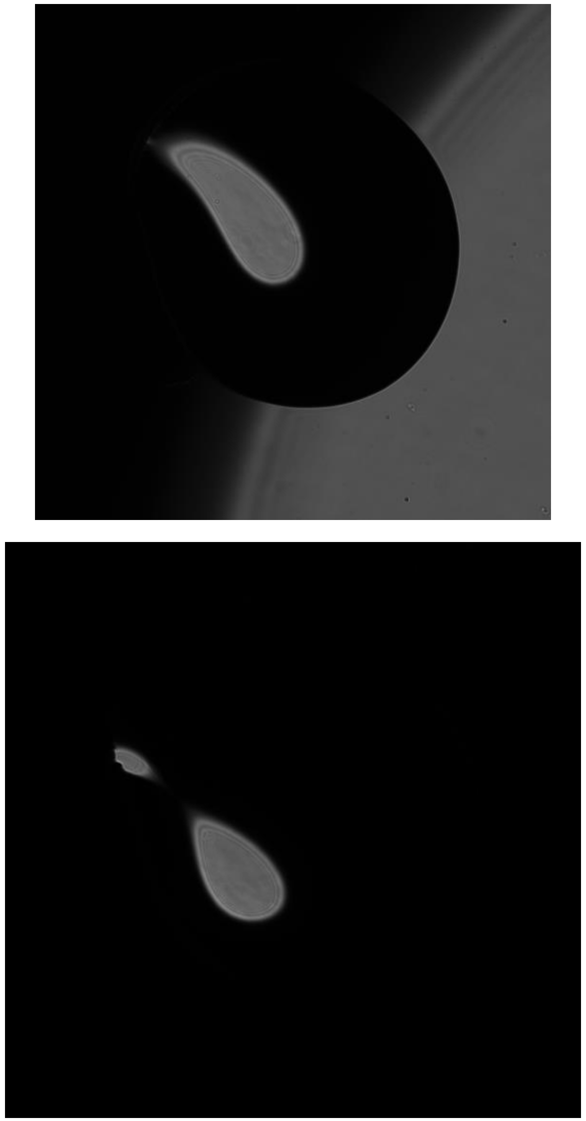


Experimental images

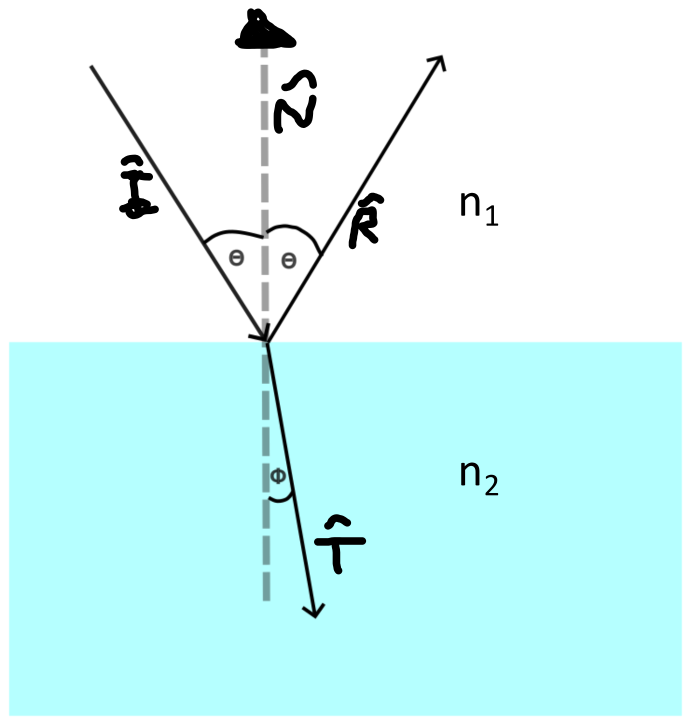








Ray tracing



$\theta_i = \theta_r$

$n_1 \sin\theta = n_2 \sin\Phi$

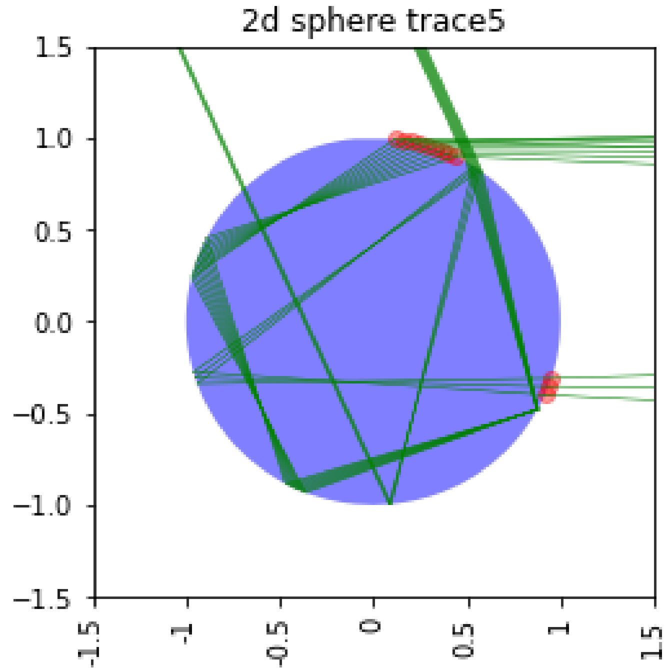
$$\hat{\mathbf{T}} = \alpha \hat{\mathbf{I}} + \beta \hat{\mathbf{N}}.$$

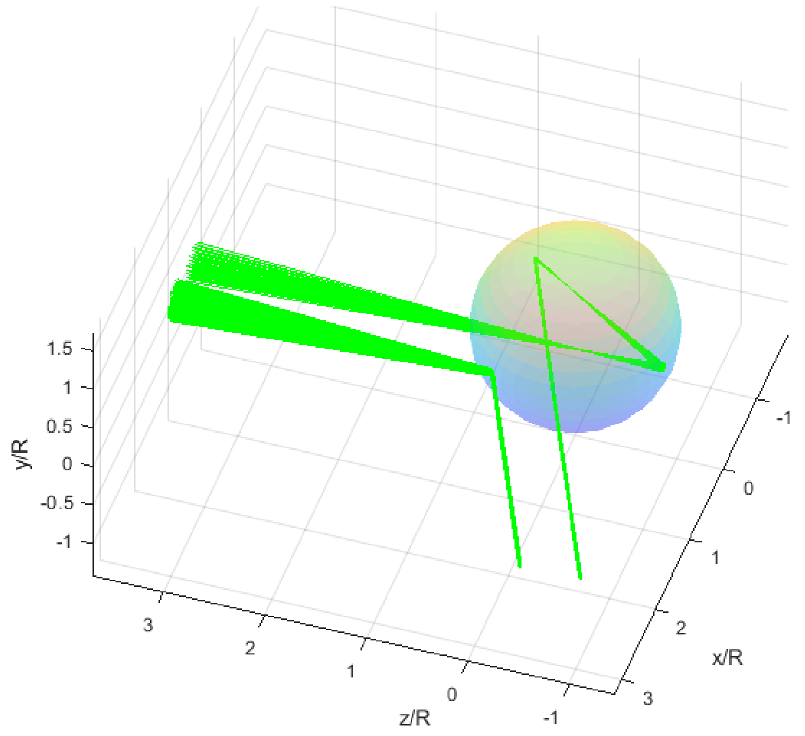
and one finds that $\alpha = (n_1/n_2)$, $\beta = (n_1/n_2)\cos(\theta_i) - \sqrt{1 - (n_1/n_2)^2 \sin^2(\theta_i)}$.

Similarly we write

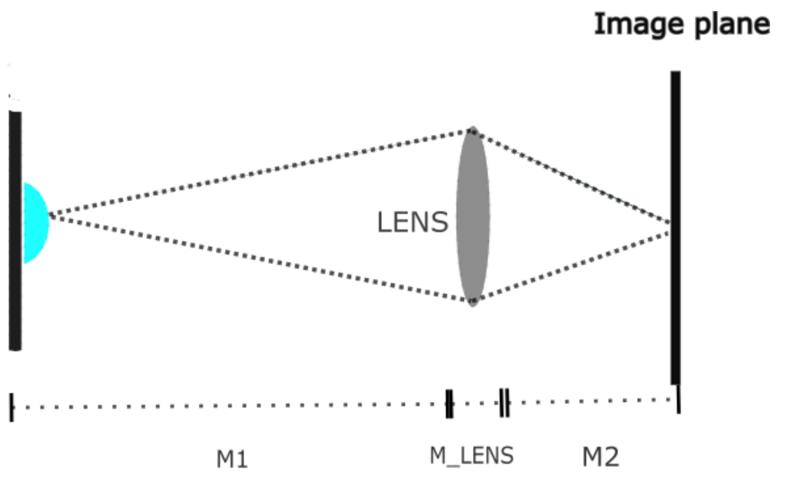
$$\hat{\mathbf{R}} = \gamma \hat{\mathbf{I}} + \sigma \hat{\mathbf{N}}$$

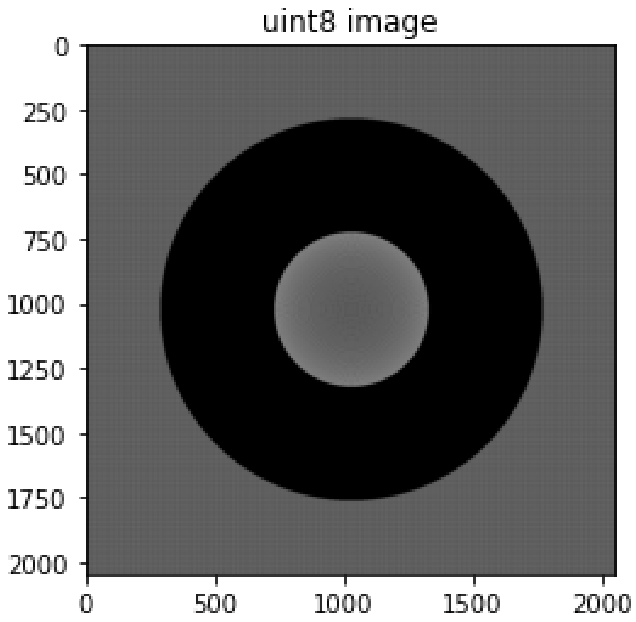
with coefficient values $\gamma = 1$, $\sigma = -2(\hat{\mathbf{I}} \cdot \hat{\mathbf{N}})$.

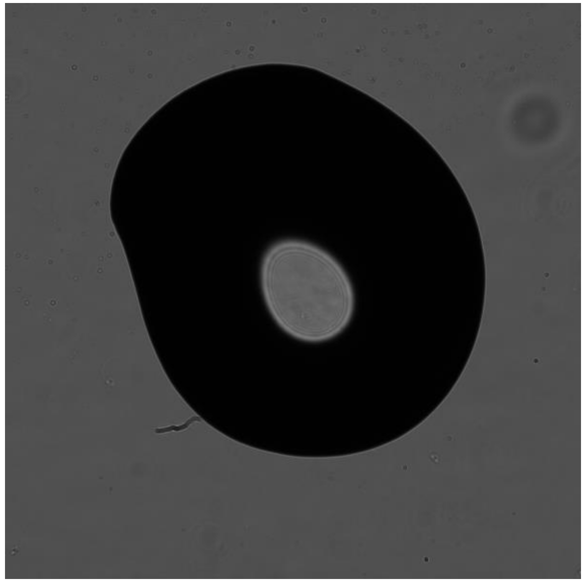




Simulated imaging







$$M_{\text{system}} = M_3 M_{\text{lens}} M_1 = \begin{bmatrix} 1 & z_2 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 \\ -\frac{1}{f} & 1 \end{bmatrix} \begin{bmatrix} 1 & z_1 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} 1 - \frac{z_2}{f} & z_1 + z_2 - \frac{z_1 z_2}{f} \\ -\frac{1}{f} & 1 - \frac{z_1}{f} \end{bmatrix}$$