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Optical Resolution (sharpness, blur)

spectral Resolution $\mathcal{R} = \frac{\lambda}{\Delta\lambda}$

$$\begin{aligned}
&- Prismawith L \equiv \text{base length}(\text{angle} \equiv \varepsilon): \\
&\frac{\lambda}{d\lambda} = -L\frac{d\eta}{d\lambda} \\
&- \text{Diffraction Lattice}: \frac{\lambda}{\delta\lambda} = nN \\
&- \text{Interferometer}: \frac{\lambda}{\Delta\lambda} = n \cdot \frac{\pi \cdot r}{1-r^2} = nN_e \\
&- \text{Planparallel Plate}: \frac{\lambda}{d\lambda} = \frac{x}{2d\tan(\beta)}\left(n - \frac{2d}{\cos(\beta)}\frac{d\eta}{d\lambda}\right)
\end{aligned} \tag{1}$$

a) object is self-luminescent, lightwaves are incoherent and resolution is restricted:

Tele) object far and big, min. size for resolution:

$$\Delta y_{min} = 1.22 \cdot f^{Obj} \cdot \frac{\lambda}{D} \tag{2}$$

where "Diameter stop" $\equiv D$ and view angle min. for "tele" resolution (object far and big):

$$\Delta\varepsilon_{min} = \frac{\Delta y_{min}}{f^{Obj}} = 1.22 \cdot \frac{\lambda}{D} \tag{3}$$

$\Longrightarrow$ optical resolution "Tele":

$$\mathcal{R}_{Tel} = \frac{1}{\Delta y_{min}} = 0.82 \cdot \frac{1}{f^{Obj}} \cdot \frac{D}{\lambda} \tag{4}$$

Mikro) object close and small, min. size for resolution:

$$\Delta y_g^{min} = \frac{1.22}{2} \cdot \frac{\lambda}{\eta} \cdot \frac{1}{\sin(u_g^{max})} = \frac{1}{2} \cdot \frac{\Delta s}{\eta} \cdot \frac{1}{\sin(u_g^{max})} = 0.61\frac{\lambda}{A} \tag{5}$$

where aperture angle from sender (source, "Obj") $\equiv u_g$, opposed to view angle $\equiv \varepsilon$ from receiver (observer, "Oku") and "Path differecence" $\equiv \Delta s$ and "Aperture stop" $\equiv A = \eta \cdot \sin(u_g^{max})$

$\Longrightarrow$ optical resolution "Mikro endo-luminescent":

$$\mathcal{R}_{Mik(endo)} = \frac{1}{y_g^{min}} \stackrel{backlit}{=} \frac{A}{\lambda} \stackrel{luminescent}{\approx} 0.82 \cdot 2\frac{A}{\lambda} = 0.82 \cdot 2\sin(u)\frac{\eta}{\lambda} \tag{6}$$

b) objct has no self-luminousity and is illuminated externally, lightwaves interfer coherently after diffraction:

Mikro) object close and small, min. size for resolution:

$$\Delta y \cdot \sin(u_g) = n \cdot \lambda \qquad n \in \mathbb{N} \tag{7}$$

$$\Delta y_{min} = \frac{\lambda}{A} = \frac{\lambda}{\sin(u_g)} = \frac{\lambda}{\frac{\lambda}{\Delta y}} \qquad A \equiv Aperture \tag{8}$$

$\Longrightarrow$ optical resolution “Mikro exo-illuminated”:

$$\mathcal{R}_{Mik(exo)} = \frac{1}{\Delta y_{min}} = \frac{A}{\lambda} = \frac{\sin(u_g)}{\lambda} \tag{9}$$