Derivation of the Resolution Limit

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From Heisenberg Uncertainty Principle

(just a rough estimation, on magnitude)

$$\Delta x \Delta p_x > h$$

The photon has a momentum

$$p = \frac{h\nu}{c}$$

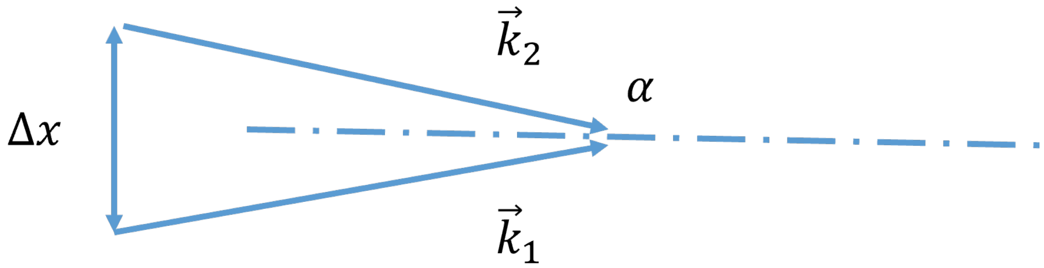
Which is equivalent to

$$p = \frac{h}{\lambda} = \hbar k$$

$$\Delta x \Delta k_x > \pi$$

$$\Delta k_x = 2k \sin\alpha \leq 2k = \frac{2\pi}{\lambda}$$

The equal sign is reached when the lens pupil reaches infinity.



($\alpha \to 90$, $\sin\alpha \to 1$)

$$\Delta x > \frac{\pi}{\Delta k_x} = \frac{\lambda}{2}$$

带入光场的 p，最大的

推导到 x 跟 k_x 的关系

k_x 最大是 k，这个就是衍射极限了

即使透镜无限大也成立

Super-Resolution

Use evanescent waves: $k_x \to \infty \longleftrightarrow \Delta x \to 0$

If we make k_x large enough, larger than k, the resolution limit can be broken.

高速探测

用来探测光场的探测器，响应速度比光场的频率大很多

外差干涉技术-》相位分辨