Which telescope, optical or X-ray, would have higher resolving power for the same aperture? Calculate the magnitude of the faintest object that a 20 m optical telescope can detect.

Answer:

The angular resolution (in angular seconds) of optical telescope is $\alpha = 206265'' \frac{1.22\lambda}{D}$, where λ is wavelength of rays, which is detected in telescope, D is diameter of objective of telescope.

Wavelength of X-ray is shorter than the optical rays. Whence, it seems, that the resolution power of X-ray telescope is larger.

But it isn't the anything material, which can make well refract or reflect X-rays as metals reflect or glass refract the light.

Whence, the angular resolution of optical telescope is higher.

We can calculate the maximum magnitude of stars if we use the eyes as detector

$$m = 2{,}1 + 5 \backslash lg\ D$$

where D is measured in millimeters. For $D = 20m = 20000mm$

$$m = 2.1 + 5lg20000 = 2.1 + 5 \cdot 4.3 = 23.6$$

The angular resolution for $\lambda = 550\ nm$ $\alpha = 206265'' \frac{1.22 \cdot 550nm}{20000mm} = 0.0068''$