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Singularity

General Astronomy

To find:- Angular resolution (θ)

Given, $D = 10\ m$

$\lambda = 550\ nm$

Acc. to Rayleigh Criterion,

$$\sin\theta = 1.22\frac{\lambda}{D}$$

As $\theta \to 0$, $\sin\theta \approx \theta$

$$\theta = 1.22\frac{\lambda}{D}$$

$$\theta = 1.22 \times \frac{550 \times 10^{-9}\ m}{10\ m}$$

$$\theta = 67.1 \times 10^{-9}$$

$$\boxed{\theta = 6.71 \times 10^{-8}\ rad}$$

1 radian = 206265 arcseconds

$\Rightarrow 6.71 \times 10^{-8}$ radians = 0.01384 arcseconds

2. Radio telescopes are astronomical instruments used to detect radio waves emitted by celestial objects like stars, galaxies, black holes, pulsars etc. They have a large parabolic dish which collects/ detects the waves. These waves are then converted to electrical signals using a receiver. Then the data is processed using a computer. Other components are amplifiers, converters etc.

Single dish radio telescopes have one large antenna dish which collects data, while Radio Interferometers (array of single radio telescopes) collect data using antennas which are spread across thousands of km. The data is combined together to get the output.

Comparision with Optical telescopes.

Radio	Optical
(1) Detects radio waves	(1) Detects visible light
(2) Wavelength ranges from m to mm	(2) Wavelength is 400nm - 700nm
(3) Can pass through clouds, dust.	(3) Blocked view due to clouds, light pollution, dust.
(4) Works 24/7.	(4) Best works only during night.
(5) Parabolic antenna collects radio waves.	(5) Lens / Mirror system used to magnify.
(6) Detects CMB, Pulsars, Quasars	(6) ~~Detects~~ Can see Supernovae, eclipses, galaxies
(7) Applications - i) Galaxy formation ii) Detects 21 cm spectral line of HI which we can use to map spiral arms of Milky way iii) Detect black holes	(7) Applications - i) View nebulae, planets, Sun ii) Detect exoplanets iii) Study galaxy evolution iv) Spectroscopy to find composition

3. Event horizon or the boundary of no return is a mathematical boundary beyond which even light cannot escape. Due to the immense gravitational pull, no light, no information, nothing can escape and it will be pulled towards "singularity". Singularity is defined as a point of infinite density at the centre of the blackhole. The event horizon of a non rotating, uncharged blackhole (Schwarzschild) is given by the Schwarzschild's radius (R_s)

$$R_s = \frac{2GM}{c^2}$$, M is the mass of blackhole.

If an external person is observing a person at the event horizon or near to the event horizon, the time seems to be very slowed due to gravitational time dilation. There will be extreme red-shift of light.