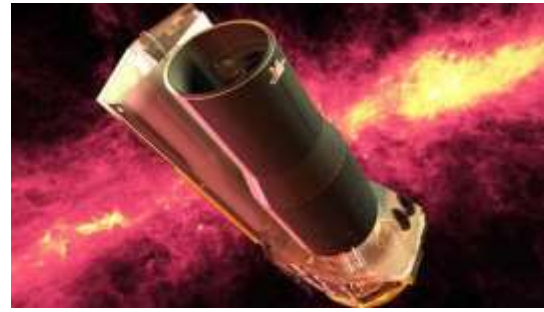


Infrared Astronomical Satellite (IRAS)

➤ Infrared telescope in space



How does it work?

<http://sciencing.com/infrared-telescope-work-4926827.html>

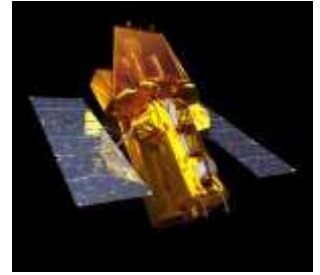
- Infrared telescopes use the same components and follow the same principles as visible light telescopes; they use a combination of lenses and mirrors to gather and focus radiation onto special detectors and then the data is translated by computer into useful information.
- The detectors are usually a collection of specialized solid-state digital devices: often the material for these is the superconductor alloy HgCdTe (mercury cadmium telluride).
- The entire telescope has to be kept to a temperature of just a few degrees above absolute zero because otherwise the telescope itself would emit infrared radiation (heat) which would interfere with the observations.

Mission/uses

http://coolcosmos.ipac.caltech.edu/cosmic_classroom/cosmic_reference/irastro_history.html

- IRAS was successfully launched on January 25, 1983.
- It revealed that some young stars have disks of minute, solid dust particles, suggesting that such stars are in the process of forming planetary systems. (It can detect the early formation of stars)
- It has discovered 6 new galaxies
- It can detect radiation thought to be from the merge of 2 galaxies.

Swift satellite



- **Gamma ray telescope based in space**

How does it work?

<https://www.reference.com/science/gamma-ray-telescope-work-bcddbfeaa873cdd2#>

- Gamma ray telescopes operate on satellites and carry special detectors tuned to measure high-energy gamma rays at various energy levels.
- Astronomers aim the satellite at potential gamma ray sources and map the resulting data.
- Sometimes, the data is filtered to remove low-level gamma radiation and reveal significant emissions.

Missions/uses?

<https://swift.gsfc.nasa.gov/>

- It has discovered Gamma-ray bursts (GRBs) which are the most powerful explosions the Universe has seen since the Big Bang.
- Swift satellite has observed and located star explosions that have happened in the early Universe.
- It has been used to observe and locate the formation and activity of comets and asteroids.

Chandra X ray telescope

➤ X Ray telescope in space



How does it work?

- NASA's Chandra X-ray Observatory is a telescope specially designed to detect X-ray emission from very hot regions of the Universe such as exploded stars, clusters of galaxies, and matter around black holes.

http://chandra.harvard.edu/about/telescope_system.html

- The Chandra telescope system consists of four pairs of mirrors and their support structure.
- An X-ray telescope's mirrors must be facing almost perpendicular to the path of incoming light and not curved like normal optical lenses.
- Chandra has four pairs of mirrors. X-rays hit the top mirrors in each pair then skip down to the secondary mirrors.
- After bouncing off the mirrors, the X-rays travel down a 26-foot tube toward the telescope's scientific instruments, located at the other end.

Uses/mission

<http://chandra.si.edu/about/spacecraft.html>

- Since it was launched on July 23, 1999, the Chandra X-ray Observatory has been NASA's flagship mission for X-ray astronomy, taking its place in the fleet of "Great Observatories."
- NASA's Chandra X-ray Observatory is a telescope specially designed to detect X-ray emission from very hot regions of the Universe such as exploded stars, clusters of galaxies, and matter around black holes.
- It also detects quasars.

The Gran Telescopio Canarias

- **Optical telescope based on Earth**

<http://www.brighthub.com/science/space/articles/52492.aspx>



How does it work?

<https://www.britannica.com/topic/Gran-Telescopio-Canarias>

<http://www.gtc.iac.es/gtc/gtc.php>

- **Gran Telescopio Canarias (GTC)**, the largest optical telescope in the world. It is a reflecting telescope with a mirror that has a diameter of 10.4 metres (34.1 feet).
- It is located at the Roque de los Muchachos Observatory on La Palma (2,326 metres [7,631 feet]) in the Canary Islands of Spain.
- As of 2009, it became the world's largest single-aperture optical telescope.
- It is made up of three mirrors; the primary mirror consists of 36 individual hexagonal segments that together act as a single mirror and along with the secondary and tertiary mirrors they collect light.
- The scientific instruments that are placed in the focal station then analyse and detect the light, and store the final data.

Uses/missions

- The GTC is designed to study the nature of black holes, as well as the more distant stars and galaxies in the Universe and the first conditions after the Big Bang.

The Hubble Telescope

➤ Optical telescope based in space



How does it work?

http://www.bbc.co.uk/science/space/universe/exploration/hubble_space_telescope

- Hubble is used to create images from the Universe's visible light, free from the distortion caused by the Earth's atmosphere. It also has instruments that detect invisible infrared and ultraviolet radiation.
- Hubble has an 8ft primary mirror and light is reflected off the primary mirror and onto the secondary mirror.
- It contains scientific instruments to interpret the data.

Uses/missions

<http://www.space.com/15892-hubble-space-telescope.html>

- Hubble has detected black holes
- Hubble has also studied the atmospheres of planets revolving around stars similar to Earth's sun.
- Hubble has images of nebulas and supernovas. (Different stages in the lifecycle of a star)
- It has images of Andromeda which is a galaxy next to our Milky way.

Lovell Telescope

- Radio telescope based on Earth



How does it work?

<http://www.jodrellbank.net/visit/whats-here/lovell-telescope/>

- The Lovell Telescope is a radio telescope at Jodrell Bank Observatory in Cheshire.
- It has a huge white bowl which is the part of the telescope that intercepts incoming radio waves and reflects them from the steel surface into the focus box. Here a small aerial picks up the radio waves and sends them into a sensitive radio receiver.

Uses/mission

http://www.bbc.co.uk/manchester/content/articles/2007/09/20/051007_jodrell_factfile_feature.shtml

- Lovell is used to discover new distant pulsars. (Pulsars are large neutron stars)
- Used to track Russian and US Space probes.
- It is also used to detect long range missiles.
- Used to explore dark energy and see the first stars and galaxies.

Unit 3C: Methods used to observe the universe

TASK: You need to produce a leaflet/booklet that outlines 3 or 4 methods used to observe our Universe.

Include:

- At least **3 different methods: some need to be telescopes based on Earth** and some need to be **telescopes based in space.**

For each of your methods include:

- The name of the method
- A picture of the telescope/satellite
- Where it is based (on earth/in space)
- How it works (is it an optical telescope detecting light/ does it detect gamma rays etc.)
- Some of its missions/uses (has it been used to investigate stars, planets etc.)
- An advantage and a disadvantage of the method

Advantages and disadvantages

IRAS – Infrared radiation is absorbed by the Earth's atmosphere so it is an advantage that IRAS is in space so that it can detect the infrared radiation. It can detect objects that light telescopes cannot.

A disadvantage is that with it being in space, it is expensive to repair and maintain as astronauts are needed.

Swift - IRAS – Gamma radiation is absorbed by the Earth's atmosphere so it is an advantage that Swift is in space so that it can detect the gamma radiation. It can also detect objects that light telescopes cannot.

A disadvantage is that with it being in space, it is expensive to repair and maintain as astronauts are needed.

Chandra X ray telescope – Clouds can partially block X ray light so it is an advantage that the Chandra telescope is a satellite in space so it can detect x rays more easily.

A disadvantage is that with it being in space, it is expensive to repair and maintain as astronauts are needed.

GTC – It is based on the ground so it is cheaper and easier to repair and maintain. Also its large size means that it can reflect more light and create clearer images.

A disadvantage is that it can only be used in the night and with clear skies. It cannot detect clear images if there is cloud cover.

The Hubble Telescope – With this telescope being in space it can detect clearer images because it is above any cloud cover and it is not affected by pollution on Earth.

A disadvantage is that with it being in space, it is expensive to repair and maintain as astronauts are needed.

Lovell Telescope – It detects radio waves which mean that it can operate during the day and in cloudy weather. It is not affected by pollution.

A disadvantage is that due to its large size, it is expensive to maintain and repair and it takes up a lot of space.