

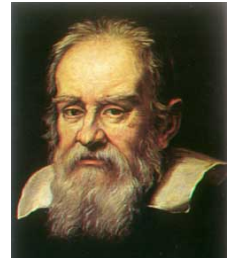


Lunar CRater Observation and Sensing Satellite

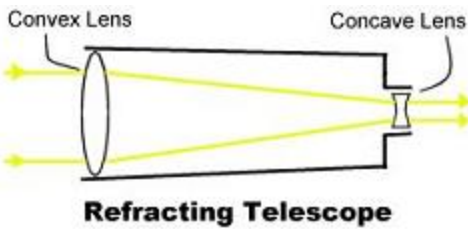
Celebrating the Telescope

It has been 400 years since Italian Astronomer Galileo Galilei began using a telescope for astronomical observations. While he did not invent the telescope, his use of it to study the moon and planets revolutionized our perception of Earth's place in the universe.

Telescopes collect light or electromagnetic radiation¹. Refracting telescopes², like Galileo's, dominated the first three hundred years of telescopes built for research. A lens at the top of the refractor collects light from across its surface, and focuses behind the lens to form an image. The largest refractor that it is possible to build because of weight and manufacturing constraints has a 40 inch diameter. It becomes difficult to support a lens much larger than that since, for light to pass through it, it can only be held from the edges.

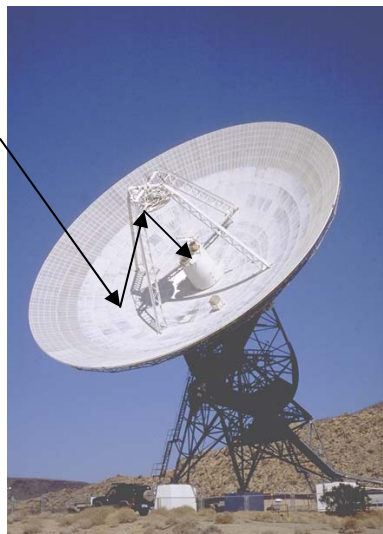
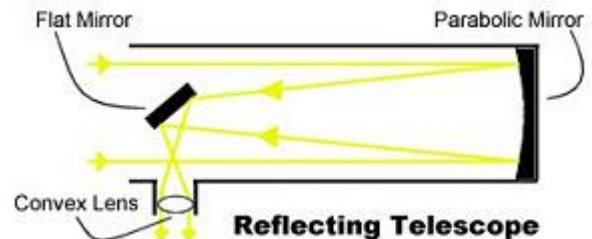


Galileo Galilei
Credit: Original portrait by Justus Sustermans painted in 1636



Courtesy NASA/JPL Caltech

Astronomers need larger telescopes in order to see greater detail in their images. How much detail a telescope can see is dependent upon the wavelength of the light being observed, and the diameter of the collecting area of the telescope.



Radio Telescope

During the International Year of Astronomy in 2009 Galileo's observations through a telescope four hundred years ago will be celebrated. In this same year, students around the world will use an equivalent instrument in the radio region of the electromagnetic spectrum to help guide the LCROSS spacecraft to the Moon.

Reflecting³ telescopes solved the size limitations of refracting telescopes. With reflectors, light is brought to a focus by a mirror rather than a lens. Since light bounces off the surface of a mirror, and does not have to pass through it to be focused, a large mirror can be supported from behind. Mirrors can be configured in innovative ways to permit reflectors like the Keck telescopes on Mauna Kea, Hawaii to have diameters of 10 meters (about 33 feet), and even larger reflectors are being planned.

Radio waves or microwaves have wavelengths much longer than visible light. To achieve even the detail of modest visible light telescopes, radio telescopes which collect light in the radio region of the spectrum, require a larger collecting area. The concave⁴ dish on a radio telescope is analogous⁵ to a telescope mirror. Radio waves are reflected by the dish to a focus for analysis. A single radio telescope may have a diameter of 100 meters.

1: Electromagnetic radiation - radiation consisting of waves propagated through the building up & breaking down of electric and magnetic fields; include radio, infrared, light, ultraviolet, x-rays, & gamma rays. 2: Refracting telescopes - uses a convex objective lens & a concave eyepiece lens. Galilean telescopes produce upright images. Galileo's best telescope magnified objects about 30 times. Because of flaws in its design, such as the shape of the lens, the images were blurry & distorted. Despite these flaws, the telescope was still good enough for Galileo to explore the sky. The Galilean telescope was the first to see the planet Jupiter and its moons. 3: Reflecting - a reflecting telescope (also called a reflector) is an optical telescope which uses a single or combination of curved mirrors that reflect light & form an image. The reflecting telescope was invented in the 17th century as an alternative to the refracting telescope which, at that time, was a design that suffered from severe chromatic aberration. Although reflecting telescopes produce other types of optical aberrations, it is a design that allows for very large diameter objectives. Almost all of the major telescopes used in astronomy research are reflectors. Reflecting telescopes come in many design variations and may

employ extra optical elements to improve image quality or place the image in a mechanically advantageous position. Since reflecting telescopes uses mirrors, the design is sometimes referred to as a "catoptric" telescope. 4: Concave - curved inward, like the inside of a circle or sphere. 5: Analogous - similar or equivalent in some respects though otherwise dissimilar; "brains & computers are often considered analogous".

GAVRT – Goldstone Apple Valley Radio Telescope Program
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