

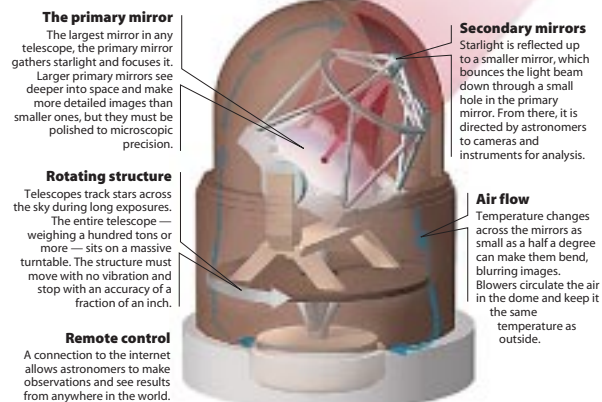
SCIENCE

Peering into the future

At world-class observatories in Chile and the United States, a host of new telescopes will be looking farther into the universe than ever before. They're larger, lighter, and cheaper, thanks to a host of design innovations, and they'll be here soon — including the world's biggest telescope, the first part of which opened in May.

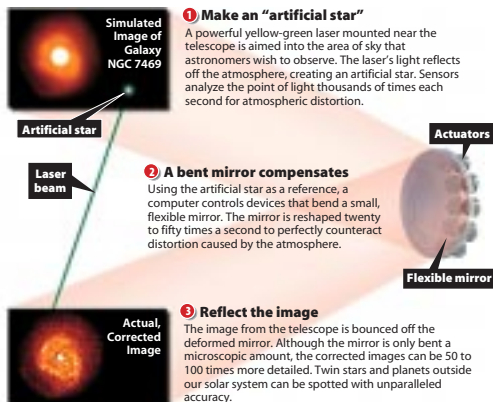
How big telescopes work

Though many amateur telescopes use lenses to magnify light, the largest telescopes use mirrors to focus starlight onto sensitive instruments or cameras.



Adaptive optics: high-tech eyeglasses

Even the most powerful ground telescopes have blurry vision, thanks to the Earth's atmosphere. The constantly swirling layers of air make stars twinkle and keep astronomers from taking sharp pictures of distant objects. Using technology from the "Star Wars" missile defense program, scientists devised adaptive optics, a method to cut through our atmosphere and take sharper pictures.

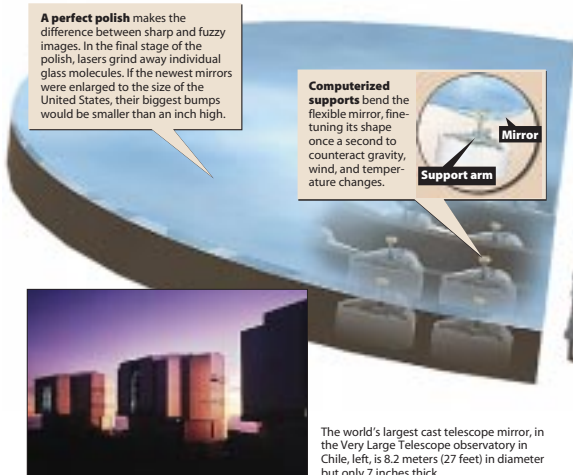


Two kinds of primary mirrors

Large mirrors gather more starlight and take sharper pictures, but the largest mirrors weigh 50 tons or more and require elaborate support systems. Two kinds of mirrors are most common: solid disks of glass cast from molds, and segmented mirrors made from a mosaic of smaller mirrors.

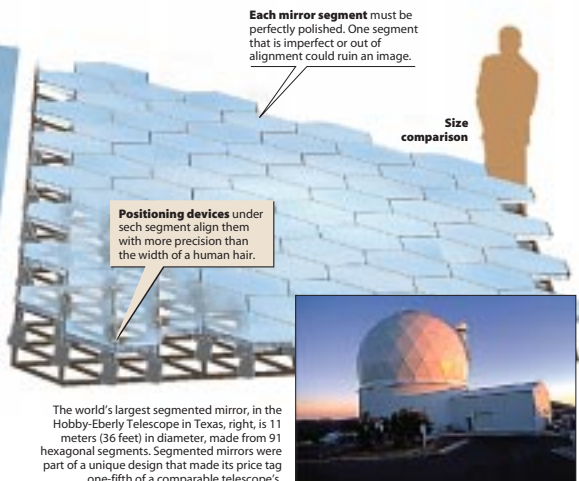
CAST MIRRORS

Telescope mirrors were once made by grinding a thick piece of flat glass down to a curved shape. Today, they're thin disks formed by pouring molten glass into a spinning mold, saving years of construction time and cutting their weight in half.



SEGMENTED MIRRORS

The very largest telescope mirrors are made of hexagonal segments instead of one large piece of glass. Segments are cheaper and lighter than a large mirror, are easier to transport to remote mountaintop locations, and some kinds can be cheaply mass-produced from a mold.



Location, location, location

Observatories are placed in areas with good "seeing," or sky visibility. These are typically high in altitude, have few cloudy or rainy nights, and no nearby cities. Here are some of the newest big optical observatories and when they became — or will become — operational:



Four eyes are better than one

Several of the world's top observatory sites house two or more identical telescopes. If each telescope focuses on a single object, their images can be combined in a complex process called interferometry. The result is sharper and brighter than any of the original images. The Very Large Telescope, under construction in Chile, will use four identical 8.2-meter (27-foot) diameter telescopes, creating a virtual telescope 16 meters (52 feet) in diameter — the largest in the world. If this array was in south Florida, under perfect conditions it could spot a mosquito in Georgia.

