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Special Telescopes for X Ray Astronomy

A problem with X Rays is that instead of reflecting off a mirror, they pass right through, says S.Ananthanarayanan.

This becomes a problem when designing reflecting telescopes that work in the X ray region.

Magnification and resolution

The purpose of telescopes is to magnify the image of distant objects while retaining the resolution of detail. The extent of magnification depends simply upon the geometry of the telescope, but the detail the magnified image will retain depends on how much light, which is information, that the telescope is collecting.

Thus, for high resolution, the lenses or mirrors of the telescope need to be large. As it is difficult to manufacture glass lenses that are more than a few inches across, the most powerful optical telescopes are reflectors, or telescopes using curved mirrors.

Visible light and infra red

The most common telescopes work with visible light and the naked eye. The great bulk of the night sky has been surveyed and mapped using just optical telescopes and human observers. But there is also an expanse of entities in space whose radiation is not in the visible region. Apart from radiation in the infra red, there is also radiation in the radio frequency range, and this radiation is important because it comes from the most distant objects in the universe.

For imaging these objects, the telescopes consist of an array of antennas, distributed over an area hundreds of kilometers across. Because images at the large wavelengths of radio waves reveal very little detail, it becomes necessary to simulate very large telescope apertures, like having a large mirror, for work in this region. Hence the need to spread the antennas over distances in kilometers.

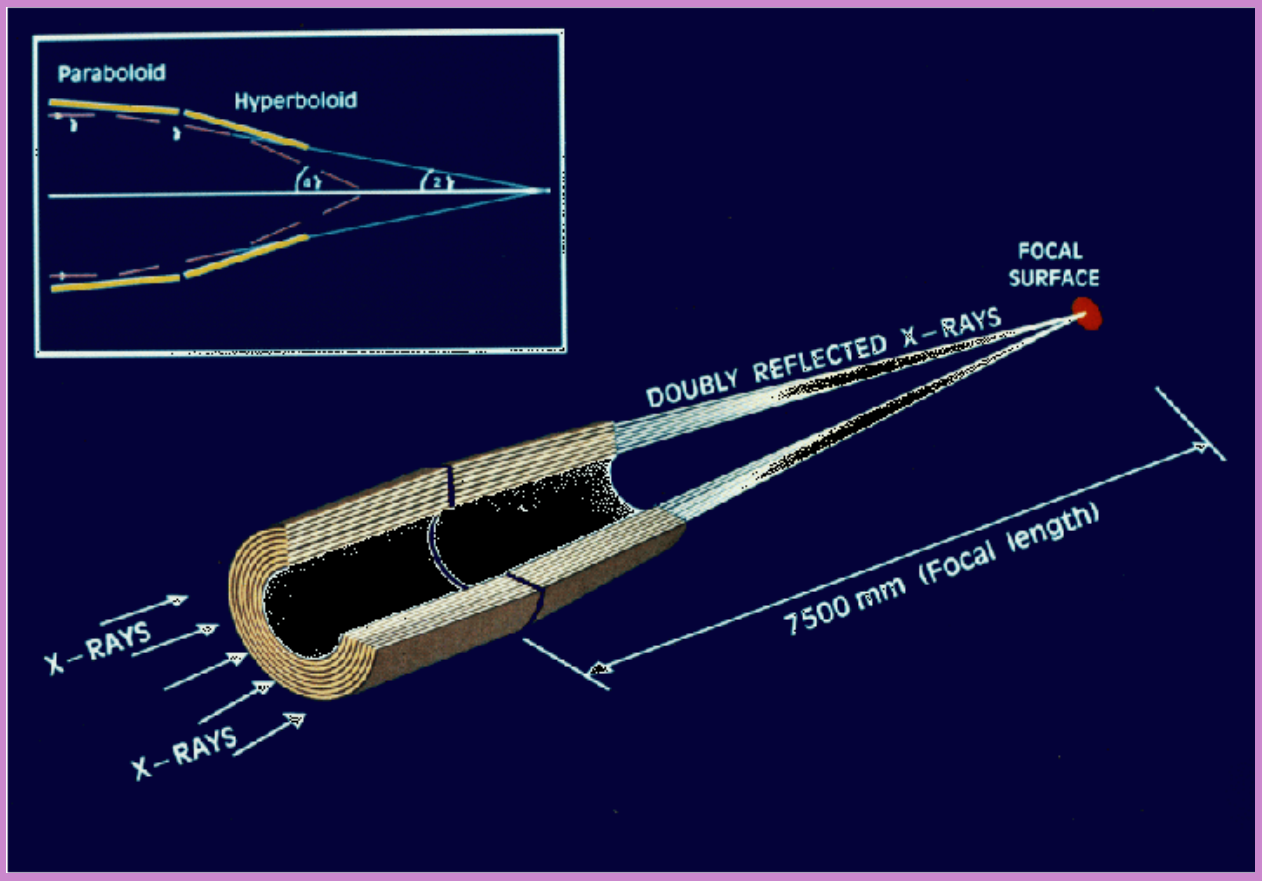
Ultra Violet and X Ray region

Just as there is radiation in the radio frequency range, there is also radiation in wavelengths shorter than visible light, viz, in the UV and shorter range. Images at such short wavelengths would be rich in detail, but the trouble is that these radiations get blocked by the earth's atmosphere. Observations hence need to be made from stations launched to huge altitudes in balloons, or, as is now feasible, from satellites. But the advantage is that these telescopes do not demand large dimensions.

X Rays are different

What is true for the UV is more true for X Rays. At X Ray wavelengths there is tremendous detail and this range is interesting because work on things like black holes is almost all in the X Ray region. Unlike ordinary light that could reflect off a parabolic mirror and throw an image, X Rays reflect only when they strike a mirror at a very shallow, 'grazing' angle.

The solution has been to set up a series of flat mirrors, to work at 'grazing' angles and simulate a large, curved mirror, and to mount them on a satellite.



The X-ray Multi Mirror telescope, launched in 1999, contains three identical X-ray mirror assemblies with an outer diameter of 70 centimeters each. With a total of 174 mirror shells, a length of almost 10 meters, a diameter of four meters and a total mass of nearly four tons, this new telescope has relayed some breathtaking pictures of cosmic events.