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Planetoid swarm swims into view

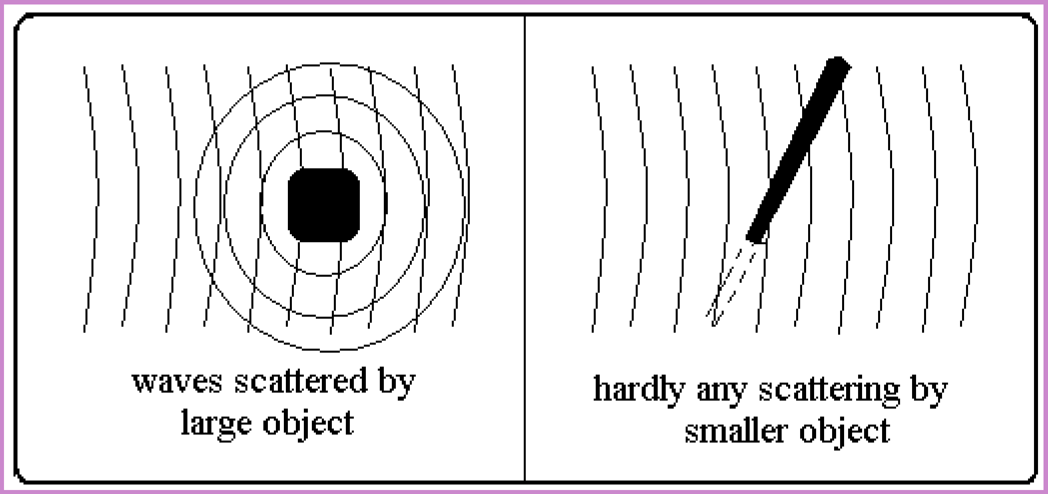
A principle of microscopy is proving useful in spotting smaller objects in the night sky, says S.Ananthanarayanan.

The discovery of the microscope, by Leeuwenhoek in 1716, proved to be turning point in biology, with the study of bacteria and life at the cellular scale. Just a little earlier, the discovery of the telescope in the 17^{th} century had opened new vistas in the night sky. Till then, in fact, only 5 planets in the solar system, Mercury, Venus, Mars, Jupiter and Saturn, which could be seen by the naked eye, were known. The discovery of the remaining planets, the moons of Jupiter and the rings of Saturn was possible only with telescopes.

Resolving power

The first thing that a microscope does is to magnify the image. Features that are too fine for the eye to make out are then made to stand out and the object is perceived as being seen from 'nearer'. A ready example is when we use a magnifying glass, which is a basic microscope, to examine fine patterns, like fingerprints. But apart from just magnifying the image, a microscope also works to collect more samples of light waves, per minute detail, of the object being viewed and hence helps actually reduce blurring of the details. This effect, of presenting detail, is called the resolving power of the lens and is related to the dimensions of the lens and also the wavelength of light.

We may know that light is a wave, just like ocean waves, and light gets reflected or dispersed in the same way as ocean waves. When waves strike an object that is large in relation to the distance between successive waves, the object deflects the waves and sets off a fresh set of waves, which interfere with the original waves. But if the object is small, the waves do not take notice and object has hardly any effect, as shown in the picture.



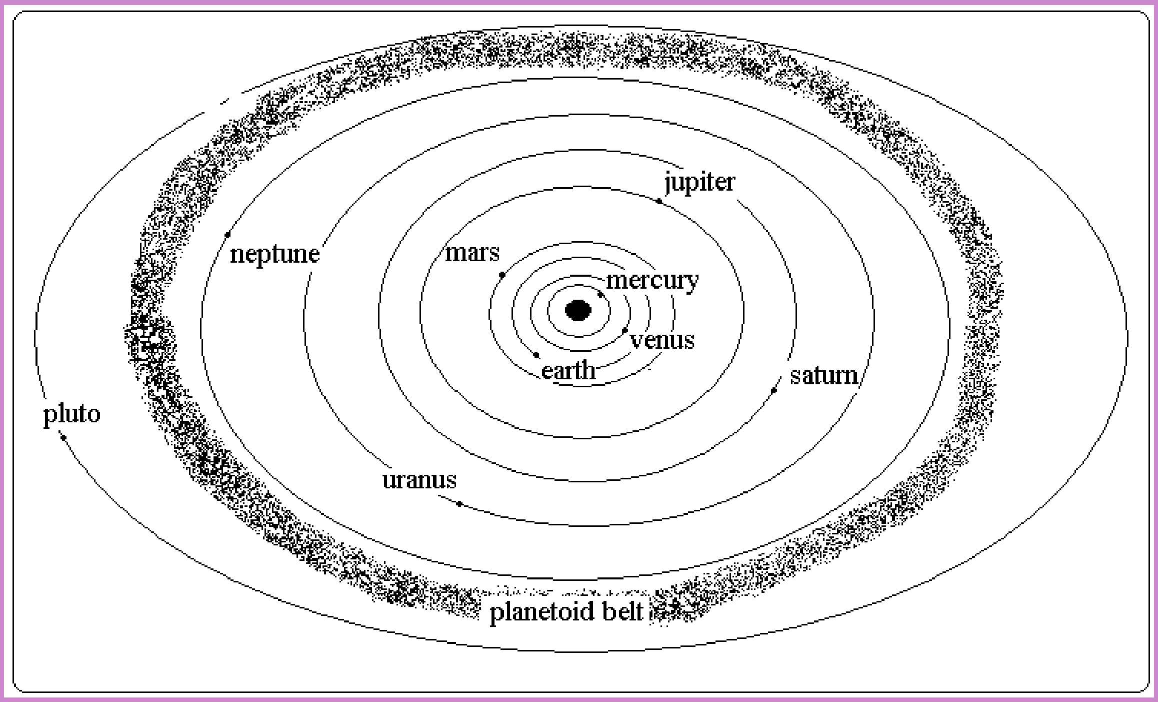
It is like this with light waves and small objects. If the objects are too small, they are not going to be seen, no matter how good the microscope lens. The answer, then, lies in using light itself of shorter wavelength and we have the ultra violet microscope, which uses special glass which allows ultraviolet light to pass or even X-ray microscopes. The ultimate is the electron microscope, which uses very short, ***matter waves***, in place of light waves!

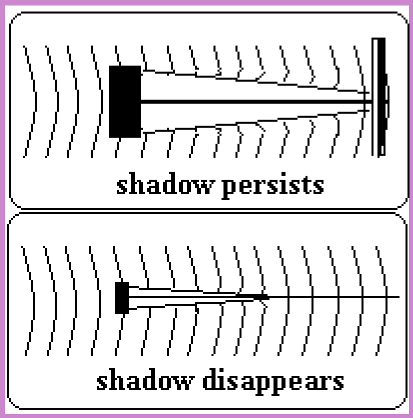
Telescopes

Resolution is a big thing in telescopes too. For greater clarity of images the size of the objective lens has been made as large as possible and great observatories boast of lenses which are over 1 metre in diameter (the telescope is 15 to 20 metres long). For all that, objects in astronomy are at such distances that other ways of improving resolution need to be found. The ***radio*** telescope looks for images in light of very large wavelength, but is able to use a radiation collector of antennas over many square kilometers. The other approach is to use shorter wavelengths, in the ultraviolet or X-rays. As the earth's atmosphere is opaque to this kind of light, the telescopes are placed in satellites that orbit the earth

Trans Neptune objects

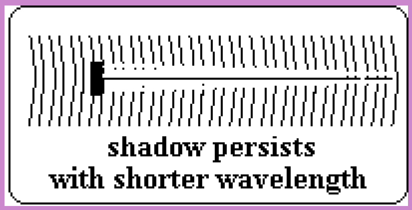
Apart from the nine planets, there are a multitude of objects orbiting the earth, particularly in a belt that lies outside the orbit of Neptune, the 8th planet from the sun. A huge number of these, each several hundreds of kilometers across, have been discovered by observation and these are important to our understanding of how the solar system may have formed. Theory also suggests that there should be a huge number of much smaller objects, some 10 to 100 metres across, but these are smaller than the limit of optical telescopes and there has been no method to check this out.





Prof Chang and others at the National Tsing Hua University, Hsinchu, Taiwan have managed to take a peek below the visible limit. When we deal with distances like 5 billion km, which is where these objects lie, visible light is just able to pass around an object a hundred metres across, so that a telescope on the earth cannot detect anything at all.

But if the light is in the X-ray range, then such an object throws a distinct shadow and can be detected.



Nature has reported this week that Prof Chang and colleagues, in Taiwan, tried to see if such objects threw a shadow in a beam of X Rays.

They analysed the data of the X-rays from important point sources in the sky, which had been recorded for a long period by the X ray telescopes of NASA, in orbit around the earth. They looked for tell-tale 'blips', or breaks in the radiation, which were indicators of an opaque lobject having crossed the path of X Rays. The record has helped the team conclude that the number of these smaller objects is as high as a quadrillion, or 1,000,000,000,000,000. This is many times the current theoretical estimate and may result in current theories being reviewed.