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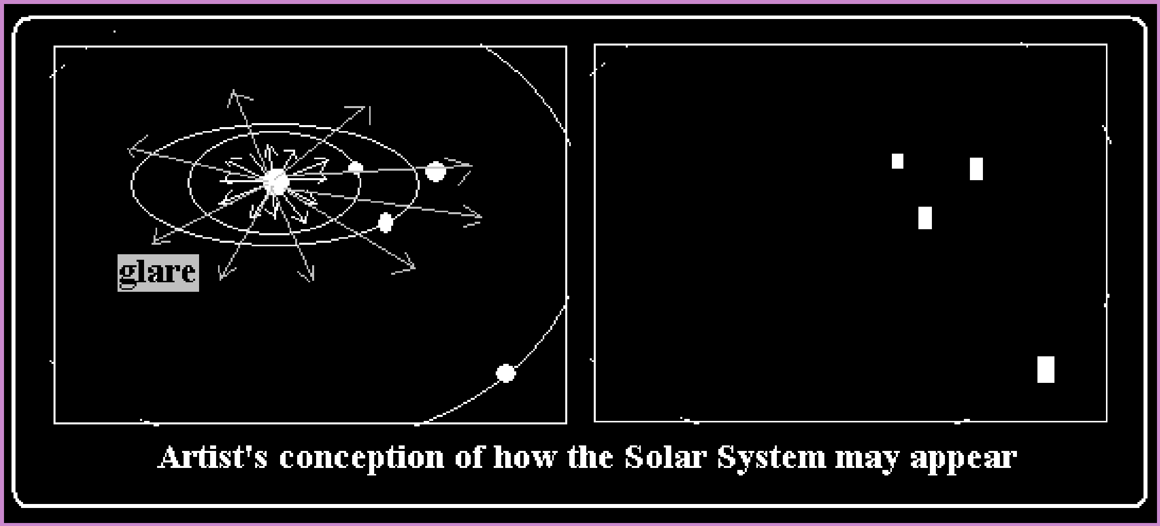
Astronomers shade their eyes

The toolbox to spot planets in other star systems has got another gadget, says S.Ananthanarayanan.

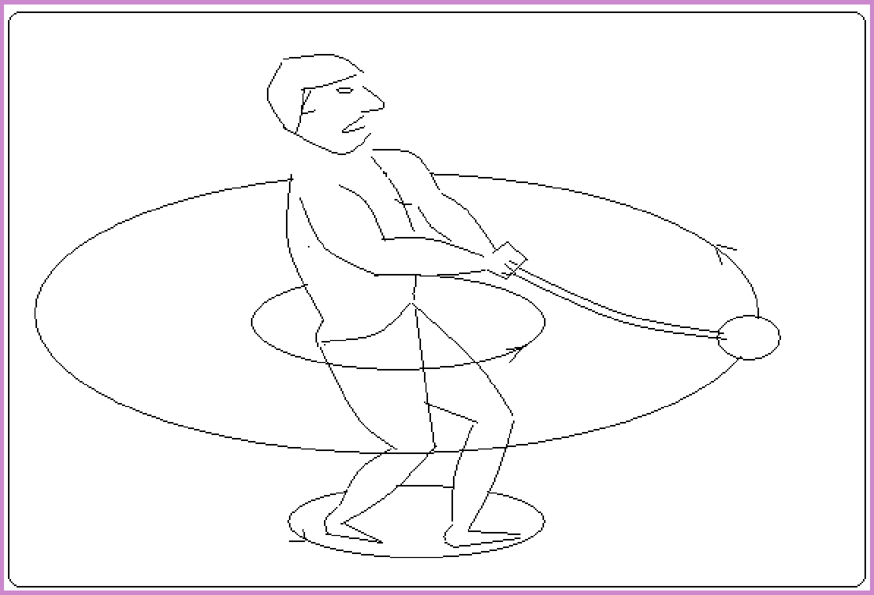


Scientists are now going to use a shade to block out the mother star so that the tiny planet bursts into view. It is like the way we shade our eyes to look hard and see something in bright sunlight. But in the case of stars, the shade needs to be shaped just right, so that light does not 'bend' around the shade and remain, to block out the planet.

Spotting planets

The difficulty in spotting planets around distant stars is that the star itself is just a speck in the sky, and a blur of brightness through a telescope. A planet in orbit around the star, and only reflecting the light it receives from the star would be far too dim to be visible. Even the planets of our own solar system, like Mars, Venus, are just dots in the sky. What hope is there of spotting a planet in a star system that is so far that it is itself barely visible?

Nevertheless, more than 200 'extrasolar' planets, or 'exoplanets', as such bodies are called, have been detected. They have not actually been seen – their presence has been 'deduced', from the slight wobbling that things orbiting around each other tend to produce. This is like a 100 kg hammer thrower who is swinging a 7.26 kg ball of steel around also bobs backward and forward as the ball begins to go around.



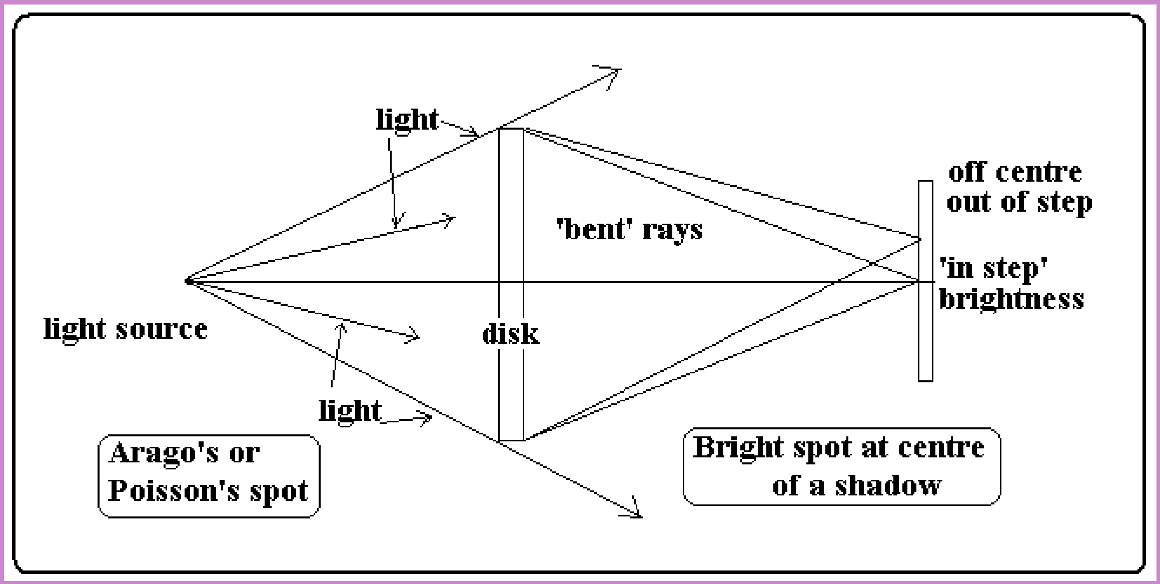
When the star wobbles, the light emitted changes slightly in colour. This is like the sound from a railway engine changes from shrill to less shrill as it speeds past. Scientists work out how fast the star is wobbling by looking for changes in the wavelength of light from the star. And from this, they work out what kind of planet must be the reason for the wobble.

This method, however, only works for fairly large planets, which produce noticeable wobble. And still, we do not actually get a glimpse of the planet, to find out whether it has oxygen, water vapour, and other things that interest us a lot. Recently, two planets have actually been 'seen', with the help of the infra-red light they radiate. But this again, is not as useful as 'seeing' the light in the visible range.

The sunshade

A method that has been used for studying the corona, or the area just around the sun has been to block out the disc of the sun with the help of an opaque disc inside the telescope itself. This blocks out the brightness of the sun's inner disc and helps photographing the outer regions.

A similar method to bock out a star could also be used, with the disc not inside the telescope but out in space, to block the light from the star, and with a little hole to let in the light from the satellite. But the trouble with this approach is that the property of light to ***bend*** around obstacles, which arises out of the ***wave nature*** of light, creates too much of glare even with a ***starshade*** in place.

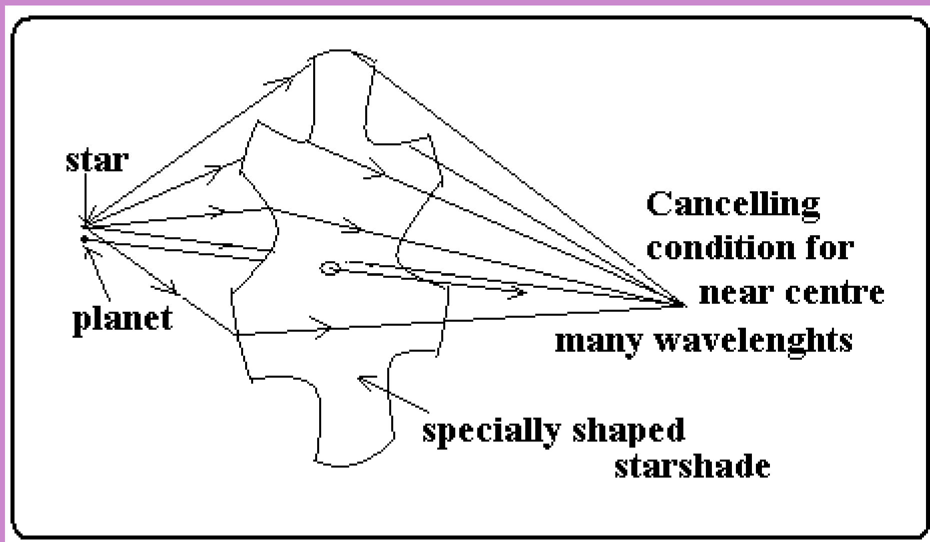


The effect is known as the ***Arago's spot*** or the ***Poisson spot***. If the shadow of a circular disc, from light from a point source, is thrown on a screen, there is a bright spot right at the centre of the shadow! The reason is that that the illumination of the rim of the disk becomes a circular source of light, with this difference that the light waves are all '***in step***'. Because of this, when the waves meet off the centre of the shadow, the light from different parts of the rime have traveled different distances and are 'out of step'. The light then *cancels* and there is no illumination. But at the centre, the light all arrives '*in step*' and there is a bright spot.

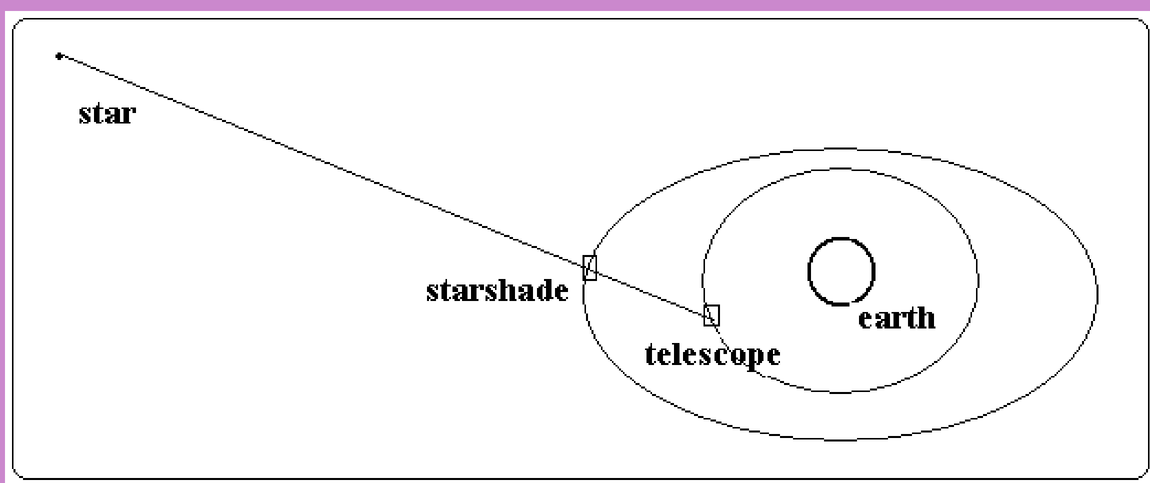
A way out

Using a circular shade is thus not going to work in cutting out the glare when trying to see planets. A solution is to modify the shape of the disc, so that half of the light coming from the rim is just out of step and the light cancels anyway. Yes, this would work, but a simple change in the shape would work only for one wavelength of light. For a slightly different wavelength, this would cause some blurring of the bright spot, but not solve the problem.

Astronomer ***Webster Cash*** at the Univ of Colorado at Boulder has worked out a shape for the disk that would help block the light from the star in a fairly wider range of shades, so that a planet around a star could actually be seen.



Using the mathematical theory of light in waves, Cash has developed a ‘sunflower petal-like’ shape of a starshade which is effective for a range of colours of light. A shade about 50 metres across, and managed by a spacecraft some 40,000 kms beyond an orbiting telescope, can throw a dark shadow that allows an earth sized planet around a star to be actually seen!



The dismay of scientists that a project called the ***Terrestrial Planet Finder***, was shelved for want of funds, has been relieved by the birth of a new project, the ‘***New Worlds Imager’***, which is working out how to get the new starshade in place!