Celestial Comeback

Planets are in Orbit Again

By J V NARLIKAR

IN the early days of astronomy, planets occupied centre stage. Their irregular movements across the heavens singled them out for special attention. They inspired true science as well as superstitions. To them the physicists owe the appreciation of the first of the basic laws of nature, the law of gravitation.

However, as astronomical techniques improved, the menu of the observer's table expanded to stars, galaxies, quasars, clusters and superclusters. Likewise, the theorist got bolder and pushed available theories to greater levels of achievement, in attempts to understand the increasingly fantastic cosmic phenomenon. In all this hullabaloo, the planets got left behind. That does not mean that nobody worked on the planets. But the glamour had been taken away by pulsars, quasars, speculations about black holes and dark matter, and, of course, the big bang.

However, in the last two to three years the planets have staked a claim to be included amongst these glamorous topics. An indication of this was the importance attached to them in the last triennial general assembly of the International Astronomical Union, which was held in Manchester in August. Thanks to several improvements in observing techniques, new and important issues concerning planets have come up.

Is Pluto a planet? A popular schoolchildren's question is whether there is a tenth planet. Erroneous statements in their textbooks tell them that a tenth planet has been found. Well, while one has to wait for a tenth planet to be found and confirmed, the situation has arisen casting doubt on whether the ninth planet Pluto is really a planet.

What is it if not a planet? The alternative is that it could be a trans-Neptunian object (TNO) of which several are known. These are objects that have orbits that resonate with Neptune, being close to Neptune's orbit with some periodic relationship to it. TNOs tend to have more eccentric orbits (that is more elongated than the typical planetary orbit) and these are inclined to the overall orbital plane of planets. Pluto has all these characteristics. However, although small by the typical planetary norm, it is massive compared to a typical TNO, and also holds an atmosphere.

Some astronomers liken it to the biological species called archaeopteryx, which shows features common to birds as well as to dinosaurs. That there is a doubt amongst the experts as to what Pluto is was shown by the result of a poll taken among a select group of astronomers gathered to discuss TNOs. They were asked if Pluto was a planet or a TNO. Planet got eight votes, TNO got 14, while 37 voted for its dual status...both a planet and a TNO.

So instead of a tenth planetary member of the solar system, we may have to worry as to whether we even have nine planets. Perhaps, the old Sanskrit verse saying that 'the tenth planet is the son-in-law' may still hold.

For a long time, astronomers had merely to speculate whether other stars besides the Sun have planets. No more so today, for we have growing evidence of the so-called extra-solar planets. It is interesting to see how the evidence has been accumulating.

IN BRIEF

- As newer galaxies were discovered, planets were largely ignored
- Over the last few years, they have made a comeback in astronomy
- Today, there is growing evidence of extra-solar planets

In 1983, the Infra-Red Astronomy Satellite gave clear pictures of the existence of proto-planetary discs. It is commonly believed that planet formation around a star takes place through the formation of a disc of gas surrounding a central bulge when a gas cloud in the interstellar space contracts under its own gravity. The planets form when the disc breaks up into blobs of matter. The IRAS images indicated that the star Beta Pictoris, believed to be younger than the Sun, has such a disc. Now the Hubble Space Telescope has several images of such discs. Thus planet formation seems to be a natural accompaniment to star formation.

While such direct infrared images are useful, they are good for detecting the disc but not yet sensitive enough for identifying planets individually. To detect fully formed planets, one needs further evidence. The technique used is one of observing the perturbations of the parent star.

The principle behind this is that of Newton's third law of motion, that every action produces an equal and opposite reaction. Imagine a planet (which we cannot see directly) going round a star. The star exerts a gravitational pull on the planet. So the planet must exert an equal pull on the star. Only because the star is so much more massive, it hardly budges from its place. But 'hardly' does not mean 'not at all'. There is a small shift, a tiny vibration in the position of the star, which affects the wavelength of light we receive from it. It is the same Doppler effect which we experience when we stand on a railway platform and watch an express train thunder past.

Likewise, light from the vibrating star shows ups and down of wavelength which can be picked up by accurate spectroscopy. These are extremely small, but it is a tribute to today's astronomical techniques that they can be picked up and analysed to tell us not only the mass of the planet but also how far from the parent star it is. In 1995, the star 51 Pegasi, which is similar to the Sun but is located some 40 light years away, showed evidence of a Jupiter-like planet very close to it. The planet is in fact more than half as massive as Jupiter, but is orbiting the star at a distance only five cent per that of the Earth-Sun distance.

Of course, the above technique picks out the really massive planets orbiting close to their star. For a planet like the Earth, the effect of its motion on the Sun is too small for a distant extraterrestrial to detect the current level of sensitivity.

If we go by our example, we could argue that the right ecological conditions for life to exist are on a planet not too near, not too far from the star. Thus examples like 51 Pegasi will not be of this kind. But we have to be patient. As of August this year, 49 extra-solar planets have been found. With the planets back on the astronomer's menu as main items rather than side dishes, more cases will undoubtedly come to light. Let us hope that some of them will suggest that we are not alone in this vast universe.