ASTRONOMICAL UNIT MEASURES LARGE DISTANCES IN SPACE. HERE IS AN INDEPTH VIEW

Distance units in astronomy

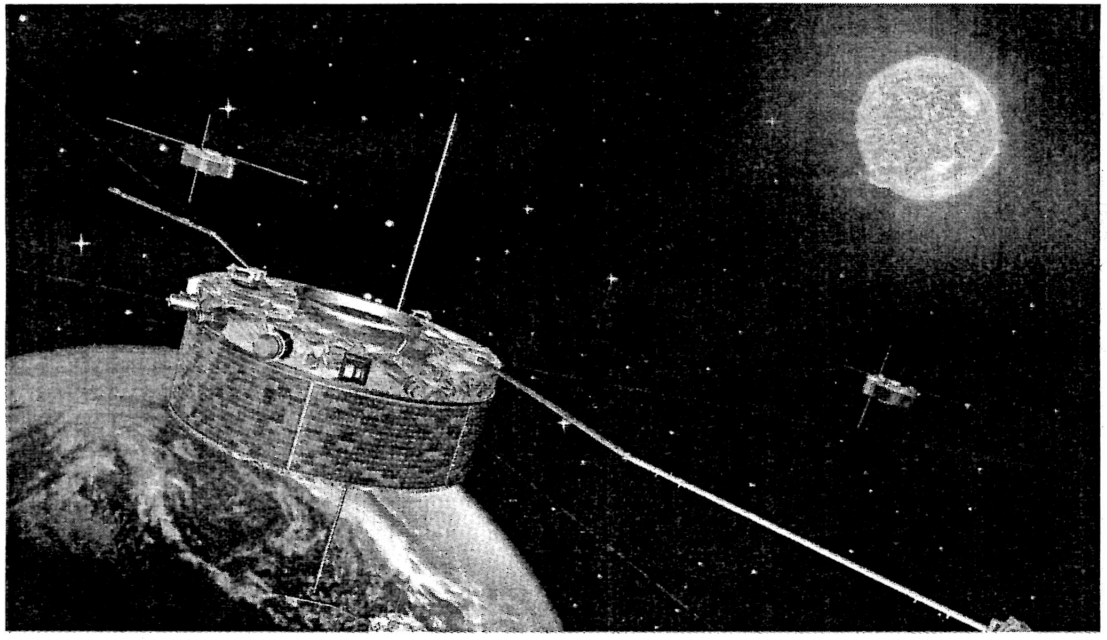
How far is Delhi from Mumbai? A distance chart may show the answer to be something like 1407 kilometres. But suppose we answer the question by saying that Delhi is 1,407,000,000 millimetres from Mumbai! We would be correct, of course, since our textbook tells us that one kilometre is equal to a million millimetres. But this answer is not very practical. The number is so large as to make it difficult to relate to our experience. And the number is too large because the unit used is very small. Millimetre may be appropriate for ants navigating across your kitchen floor, but for us humans intercity distances were best measured in miles or kilometres.

PART- IV

THE UNIVERSE YOURS TO DISCOVER

INTERNATIONAL YEAR OF ASTRONOMY 2009

DNA special



Take for example, the Earth-Sun distance. Measurements show that it is around 150 million kilometres. If we continue using the same unit of kilometre which serves us so well on the Earth, then some other solar system measures are even larger: Sun-Jupiter distance is 780 million kilometres and Neptune-Sun distance is 5,000 million kilometres. And while we get snowed by these large numbers we are reminded that we have still not left the solar system.

To deal with the large distances of the solar system, astronomers have elected to have a new distance unit, the so-called Astronomical Unit which equals the mean Sun-Earth distance. So we say that the Earth is 1 AU from the Sun, Jupiter 5.2 AU while Neptune is 30.1 AU.

The AU will work well within the solar system but not beyond. For example, the Earth is so far from the Sun that light from the Sun takes about 500 seconds to come to us. How far is the nearest star from the Sun? The stars Alpha and Proxima Centauri are so far that light from the Sun will take 4.25 years to get there. Even in the AU unit, the answer is as large as 268056. And as we probe the universe farther and farther we would get even larger numbers. So we need a bigger unit than even the AU.

One way to devise a new unit is to use the above example for guidance. Why not use the light speed as a constant in describing how far away the objects are? So a light-year is the distance travelled by light in one year. It equals approximately 9.46 million million kilometres. By the same token we have noted that one astronomical unit equals approximately 500 light-seconds.

While physicists would be happy to use a light year to measure astronomical distances, the astronomers use another unit, called the parsec. This is approximately three light years and more exactly equals 30.8 million million kilometres. To visualise the parsec we could draw an isosceles triangle with the small third side equal to 2 AU and the other two equal sides are of such a length that the small angle facing the third side is 2 seconds of arc. One second of arc is 3600th part of the degree that is commonly used for measuring angles. This means that if we saw a star located at the third vertex today and six months later, we would find a change of its direction by 2 seconds of arc. Such a star is then said to be at a parsec's distance from the Earth. The change of direction of the star is called 'parallax'. Thus the word 'parsec' is made up by joining part of 'parallax' with part of 'second' of arc.

Astrophysician Jayant Narlikar and Thanu Padmanabhan, theoretical physicist, will contribute to **DNA**'s *special series through 2009, designated the International Year of Astronomy. This is the fourth article in the series*