IN MODERN TIMES, THE TRANSITION FROM DHANU TO MAKAR RASHI NO LONGER OCCURS

Sankranti's solar connection

Jayant Narlikar & Thanu Padmanabhan

We celebrate the festival of Makar Sankranti on January 14. What does this date stand for? In a sense it is not a religious occasion but an astronomical one. Notionally it signifies the occasion when the Sun changes its apparent motion against the background of stars from southwards to northwards (Dakshinayana to Uttarayana).

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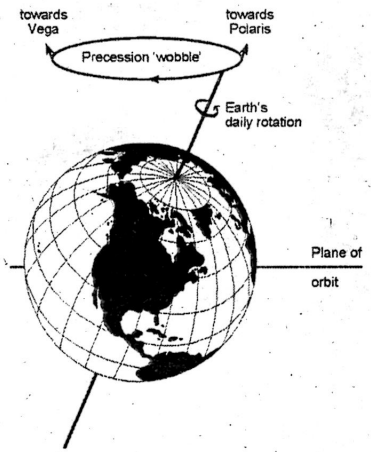
These 'north' and 'south' directions are defined with respect to the earth's equator. Although in reality the earth orbits the sun, as seen from the earth we see the sun go round the earth. In the course of one year, this motion takes the sun north of the equator for six months and south for another six months.

This motion of the sun against the background of stars is conveniently charted by dividing the belt it sweeps in the year into twelve divisions, each identified by some apparent picture made by the distant stars lying in the direction of that division. These divisions are the signs of the zodiac or rashis.

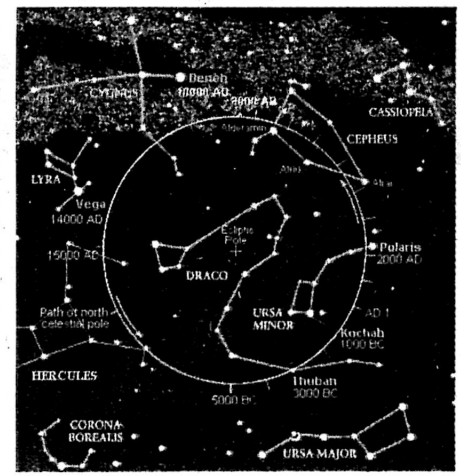


In the olden days the transition from southwards to northwards occurred at about the same time when the Sun moved from the Dhanu to Makar rashi. This changeover is called 'sankranti' in Sanskrit, and a change into the Makar rashi is indicated by the words Makar Sankranti. In English this changeover is from the sign of Sagittarius to Capricorn.

However, there is a snag in this whole system. The north-south polar axis, around which the Earth spins, does not keep to the same direction in space. So the equatorial circle changes its position in the sky and as a result, in modern times the transition into the Makar rashi no longer occurs at the time of changeover from Dakshinayana to Uttarayana.

The latter occurs on December 22, whereas the former takes place around January 14, which is some 23 days later. And this discrepancy will grow with time.

To visualize the Earth's spin take the example of a spinning top. Very often the top does not spin steadily about a direction fixed in space. Rather, its axis of spin precesses and sweeps out a cone in space. Its precession rate is slower than its spin rate, that is, the time its spin axis takes for completing one revolution, is much longer than the time its spin takes to make one round.



The change of direction of earth's spin axis takes place at the rate of about 26,000 years per one complete revolution. This is the time period during which the axis sweeps out one cone in space.

Naturally this affects any long term observations of the sky made from the earth, although human life span is too short to make any perceptible difference during our life time. One change that will come about is that the Pole Star or Dhruva would no longer appear stationary. Today it happens to lie close to the earth's spin axis.

But after a couple of thousand years the axis would have shifted and another star known as Gamma Cephei or Alrai would take the place of the Pole Star. Likewise the Makar Sankranti was close to changeover to Uttarayana, some 1,700 years ago.

— 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 third article in the series*