

Mother earth at the opera

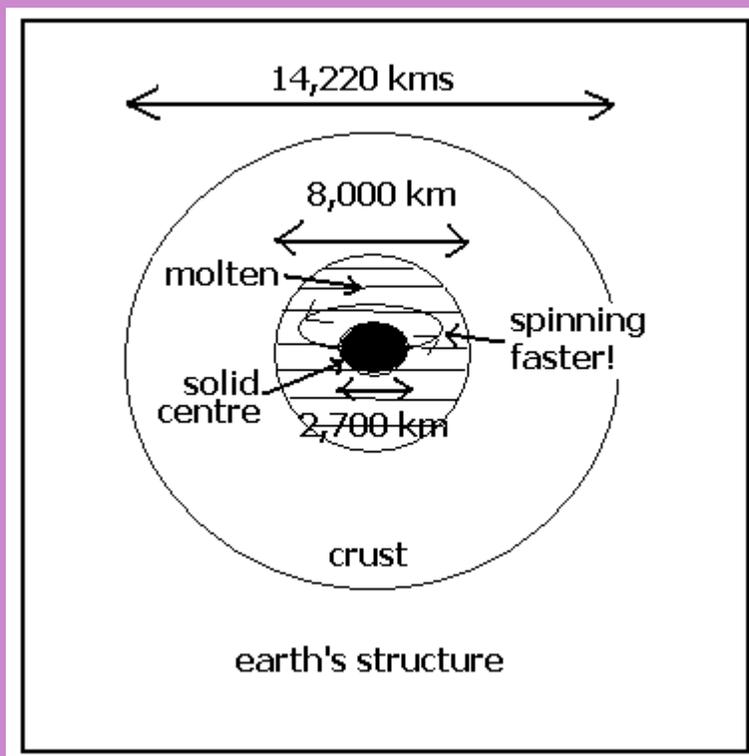
Newspaper reports are talking about the earth's core rotating faster than the rest of the planet. "How could that be?" asks S.Ananthanarayanan.

We all know that the earth turns round once in 24 hours. Research at an observatory at Columbia University has shown that this is the spin rate of only the surface of the earth. The earth's core goes round a wee bit faster – a quarter turn in the last century.

Structure of the earth

Billions of years ago the earth was one molten mass surrounded by gas and vapour. The heavy, metallic part sank to the bottom and the lighter parts were more on the outside. As the earth lost heat by radiation, these outer parts cooled and condensed, to become solids, and combining with gases in the atmosphere, to form rocks and minerals. Yet later, water vapour condensed to water, to form oceans.

But the inner part of the earth, which was rich in iron, remained molten and now had a 'blanket' of earth and atmosphere to keep it like that. And to this day, the earth has a molten core, some 8,000 kms wide. Right at the centre, the pressure gets so great that even such hot metal cannot melt and the deep centre is again solid, about 2,700 kms wide.



Rate of spin

The early history of the earth is believed to start with a much wider blob of gas and dust that pulled itself inwards by gravity and compressed into planet earth. In the process, the net motion of the different parts remained as rotation of the round, ball-like object that was formed. And at that time, it is expected that all parts of the earth would have been spinning at the same rate, like a spinning cricket ball, or even like a spinning bowl of soup.

The trouble started as parts of the earth began to change from liquid to solid. We know that when water changes from liquid to solid, as ice, it actually expands. As we cool water, it contracts, till it reaches 4°C . At this temperature, it begins to expand, till it forms ice, at 0°C . Many metals also behave like this, in that they begin to expand as they cool to near the temperature at which they solidify. A good portion of the outer crust of the earth, as the crust began to solidify, was of material like this. And so, as the outer crust formed, the crust grew a little larger than how it was when it was still liquid.

Like a ballerina

Now, the work done to set an object spinning is stored in the energy of the spin. The energy resides more in the parts away from the axis of spin than the parts near the axis. We may have noticed that the flywheel of a machine is built with a heavy rim, just for this reason. For the same weight of a flywheel, it is more effective if its weight is more to the outside than to the middle.



Ballerinas and figure skaters use this principle to adjust their rate of spin by moving their arms in and out. If a ballerina spinning with her arms stretched out should pull her arms in, the energy of spin has to show up nearer the axis than before. The result is that the dancer begins to spin faster. Conversely, if the dancer stretches her arms out, the rate of spin would slow!

This is exactly what happened when the outer part of the earth increased its girth on becoming solid – this outer part wanted to slow down. Unlike the ballerina, the outer part was not rigidly connected to the inner part – the connection was fluid. And so the outer part slowed down – and those Columbia scientists say the inner part is faster!
