SIMPLY PUT A REMARKABLE EXPERIMENT

To the early universe, via Timbaktu

In a pristine patch of Andhra Pradesh, where the air is clean, the sky is clear, there is no noise, and modern digital technology is minimal, scientists will next week seek to confirm unusual findings from space signals

AMITABH SINHA
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Timbaktu is ideal for detecting faint electromagnetic signals, and has been the site of experiments earlier as well.

TIMBUKTU, a region and a city in the African nation of Mali, has for long been the most famous description for faraway, strange unknown lands. An identically named — though slightly differently spelt — place in India, in the Anantapur district of Andhra Pradesh, is not exactly a faraway land. But it is not just any other place either.

Timbaktu is inhabited by farmers who believe in and practise sustainable agriculture and organic farming. It was a wasteland until social workers C K Ganguly and Mary Vattamattam adopted it in 1990, and transformed it into a green paradise with the help of local farmers. They named the place Timbaktu which, in Telugu, means "Sarihaddu Rekha" or the last horizon where the Earth meets the sky.

The area is surrounded by hills with unusual rock formations. The air here is clean, the sky clear, there is practically no noise, and crucially, the place has minimal footprints of modern digital technology.

It is the sort of place that scientists hunting for faint electromagnetic signals from the sky describe as radio quiet — an area where there is virtually no interference from signals produced by modern technology.

It is here that a group of scientists from the Raman Research Institute (RRI) in Bengaluru have decided to conduct an experiment, whose results, expected in about a month, could profoundly change our understanding of the early universe, specifically of events leading up to the formation of the first stars, about 3,80,000 years after the Big Bang.

These scientists have been to Timbaktu earlier as well — to capture radio signals from the sky through specially built antennas that look like a circular aluminium plate, about a metre and a half in diameter, with an oversized doorknob attached (*picture*).

Next week, by Tuesday, the scientists will travel to Timbaktu again, with modified instruments that are twice the size of earlier ones, in a bid to verify the startling observations made by a group of researchers from Arizona State University (ASU). That group had reported unusual and unexplained shapes in the spectrum of cosmic microwave background radiation that their instruments had captured at a similarly quiet place in Australia in February this year.

Cosmic microwave background, or CMB, is an all-pervasive, but weak, electromagnetic radiation from the early universe, when matter was still to be formed. "This radiation does not come from any of the objects that we see in the universe, like stars or galaxies. It is coming from a time when these things were still to be formed. This radiation is a relic from an early universe when matter and radiation were in thermodynamic equilibrium. Whenever we observe CMB, we are actually looking at the universe as it was 3,80,000 years after the Big Bang," said Ravi Subrahmanyan, director of RRI.

Ever since it was first discovered in 1964, CMB has been an invaluable source of information on the early universe. From the clues held in it, scientists have inferred that the early universe was filled with hot, dense and extremely uniform gas, mostly hydrogen, and that the first stars were formed when these blobs of gas got together under the influence of gravity. That is when visible light also made its first appearance in the universe. Scientists refer to this phase as cosmic dawn.

The spectrum produced by CMB is very smooth, Subrahmanyan said. It does, however, contain small wiggles, or deformities, in its shape. In each of these wiggles is encoded information about specific events that took place as the first stars were born. The existing theory of the universe predicts the shapes and sizes of the wiggles that can be expected to be found in the CMB spectrum in different scenarios. Thus far, theory and actual observations of CMB spectrum have matched perfectly.

The researchers from the ASU, however, reported wiggles that were very different from

theoretical predictions. "This group reported wiggles that were twice in magnitude than what is theoretically predicted... It has reported an unexpected dip in the spectrum around the 80 MHz frequency zone. The shape (of the wiggle) is completely weird and nothing like what you can get from theory," Subrahmanyan said.

Scientists have struggled to explain the findings ever since they were published in the journal *Nature* in February this year. There is huge excitement in the scientific world about these results, and a sense of anticipation about something big on the horizon.

And so, the ASU researchers are preparing to repeat their experiments to see whether they got it right. They are using the same instruments and software that they used last time. The group from RRI is trying to independently verify the claims of those researchers with their own instruments.

"The world is looking at us to give an independent confirmation. Were the deviations observed by ASU researchers real, or were they something produced by their instruments? That kind of thing (instrumental errors) is also... possible, since these are extremely difficult and delicate measurements," Subrahmanyan said.

Scientists from the RRI have been studying CMB radiation for quite some time now, but in higher frequency regions. Different frequencies in the CMB spectrum correlate to different times in the early universe. The unusual shape reported by ASU researchers was found at a relatively lower frequency. The RRI group has now recalibrated its radio antenna to capture CMB radiation at lower frequencies.

This week, the team is testing its instruments at a facility 100 km north of Bengaluru to check if everything is working fine.

Subrahmanyan said if the team from RRI succeeds in confirming the findings of the ASU researchers, the implications for physics and astronomy could be enormous.

"If our observations confirm the nature of the dip that the ASU researchers have seen, it will show that our current understanding of that time... is extremely poor... It will overturn our understanding of the... universe when the first stars were formed," he said.

The scientists are hoping to find Timbaktu as pristine as they found it last time, about a year ago. If their instruments are unable to achieve the sensitivity required to accurately capture CMB at low frequencies, they would have to travel to an even quieter location in Ladakh to carry out their experiments.

Full report at www.indianexpress.com