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UCT collaborates with SARAO as MeerKAT decodes interstellar visitor 3I/ATLAS

The University of Cape Town (UCT) has played a pivotal role in a major scientific result confirming that the interstellar object 3I/ATLAS is behaving like a comet and shows no sign of technological activity. An international team, co-led by UCT's Professor DJ Pisano, used South Africa's MeerKAT radio telescope to make the most detailed radio observations to date of this rare visitor from beyond our Solar System.

Discovered on 1 July 2025 by the Asteroid Terrestrial-impact Last Alert System (ATLAS), 3I/ATLAS is only the third known object of interstellar origin to pass through our planetary neighbourhood. Its unusual trajectory sparked public interest and speculation, including theories about the possibility of an artificial object. The new results provide clarity.

The research team from UCT, the South African Radio Astronomy Observatory (SARAO), Rhodes University and the KTH Royal Institute of Technology in Sweden focused on detecting hydroxyl (OH) signals, a known marker of comet activity. When comets approach the Sun, water ice heats, vaporises and splits into hydrogen and hydroxyl molecules. These molecules create distinctive radio signals, which MeerKAT can detect with high sensitivity.

Because 3I/ATLAS is small and never came closer to the Sun than Earth's orbit, any radio signal was expected to be faint. MeerKAT's sensitivity, ability to observe near the Sun, and its Breakthrough Listen BLUSE instrumentation made it an ideal tool for the investigation. BLUSE scans for narrowband radio signals associated with technological sources.

Observations on 20 and 28 September 2025 produced no cometary hydroxyl detection. However, MeerKAT did pick up a hydroxyl maser from a Mira variable star in the same field of view, which confirmed the system's performance. On 24 October, hydroxyl absorption at the 1665 and 1667 MHz frequencies was detected at the expected velocity. Subsequent observations on 4, 6, 11 and 12 November revealed the predicted shift from absorption to emission as the comet moved through optimal conditions.

"Detecting these hydroxyl lines allows us to confirm that 3I/ATLAS is acting like a comet and not something unusual," said Pisano, who co-led the study. "MeerKAT's sensitivity gave us a unique view of this object at a time when it was more than 350 million kilometres from Earth."

In parallel, the Breakthrough Listen team analysed BLUSE data from 5 November and found no narrowband signals between 900 and 1670 MHz coming from 3I/ATLAS. The power limit for any transmitter on the object is below 0.17 watts – weaker than a mobile phone. This shows that MeerKAT paired with BLUSE is sensitive enough to detect a phone-level transmitter at vast distances.

Pisano noted: "This is an extraordinary demonstration of South Africa's world-leading scientific capability. MeerKAT allowed us to rule out even the faintest technological signal and confirm that 3I/ATLAS is a natural object. It's a strong example of how UCT researchers and our collaborators contribute to global efforts to understand our cosmic environment."

SARAO chief scientist Dr Fernando Camilo added: "We're happy that we are contributing, alongside colleagues around the world, to a fuller understanding of this remarkable natural phenomenon – a comet likely formed in another stellar system that is briefly passing through our own."

Pisano credited the Inter-University Institute for Data-Intensive Astronomy (IDIA) facilities, which were used to obtain results quickly.

MeerKAT is operated by SARAO, a facility of the National Research Foundation, an agency of the Department of Science, Technology and Innovation.

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