

Atoms start 'talking' at high energy, paving way for quantum tech

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BENGALURU: Indian scientists have shown how atoms stop acting as loners and begin interacting when pushed into extremely high-energy states. The discovery, made by researchers at the Raman Research Institute (RRI) in Bengaluru and IISER Pune, could be a guide for building next-generation quantum computers, sensors and secure communication systems. Ordinary atoms are tiny and usually behave independently. But when excited into what are called Rydberg states, they balloon in size and become highly sensitive to their surroundings. This makes them useful for quantum technology—but also hard to control.

The RRI team cooled rubidium atoms to just above absolute zero, trapping them with lasers and magnetic fields to keep them almost still. They then used beams of light to push the atoms into very high-energy states. At first, the atoms responded with clean and predictable patterns. But beyond the 100th energy level, those patterns broke down. Instead of neat signals, the atoms produced blurred, distorted ones.

Far from being a mistake, this was the crucial sign: the atoms were no longer acting alone. They had started “talking” to each other, their responses shaped by interaction rather than isolation.

This is the first time such interaction-driven distortions have been demonstrated worldwide at such high states. The breakthrough shows exactly where atoms shift from independence—needed for precision work—to collective behaviour, which is vital for simulating complex systems.

The study was led by Prof Sanjukta Roy and her students at RRI, with theoretical modelling from Prof Rejish Nath's group at IISER Pune. Their custom-built detection system was sensitive enough to capture signals even from highly fragile states, where others had struggled.

“By mapping this delicate transition, the work places Indian researchers firmly on the global quantum map. It also offers a new tool for scientists seeking to build the devices of the future—where controlling when atoms act alone, and when they act together, will make all the difference,” the department of science and technology (DST) said.