ACHIEVEMENTS

Rapid Quantum Gas Formation through Electromagnetically Induced Transparency Cooling

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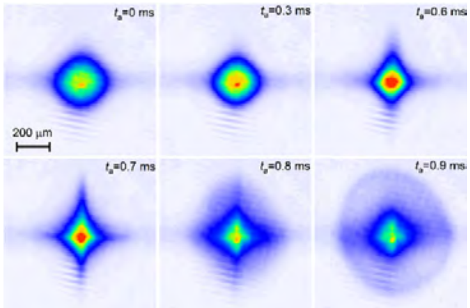
Quantum gas is a novel, non-classical state of matter, alongside gas, liquid, solid, and plasma states. In recent years, quantum gases have played a crucial role in the development of quantum science and technology, with many breakthroughs relying on experimental advancements in quantum gas studies. The condition for a regular gas to transition into a quantum gas is when the de Broglie wavelength of individual atoms exceeds the atomic spacing, a transition that can be facilitated by cooling, which increases the wavelength of matter waves. Since Nobel laureates Prof. Eric Cornell and Carl Wieman first experimentally observed quantum gases in 1995, their creation has largely depended on evaporative cooling, a process akin to cooling hot water by letting it evaporate at room temperature. However, this cooling method is inefficient and requires time for atomic collisions and thermalization to complete.



The image shows the experimental observation of the "Bosenova" collapse of the quantum gas, where the central part represents the quantum gas formed within a three-dimensional optical lattice via electromagnetically induced transparency and adiabatic expansion techniques. After the "Bosenova" collapse, atoms collide and emit a large quantity of atomic jets, forming a shell-like structure.

In a recent study published in *Nature Physics*, a quantum science research team led by Associate Professor Shau-Yu Lan at NTU's Physics Department demonstrated an exceptionally efficient method for producing quantum gases. This method involves trapping atoms in a three-dimensional optical lattice created by laser interference and employing electromagnetically induced transparency (EIT) along with adiabatic expansion to rapidly cool the atoms, achieving nearly 100% efficiency with a speed roughly 100 times faster than conventional methods. This innovative technique has significant potential to enhance applications of cold atom platforms in quantum sensing and quantum computing.

Click or Scan the QR code to read the journal article in *Nature Physics*.

Additionally, Prof. Lan's team observed a phenomenon in the generated quantum gas resembling a supernova explosion, termed a "Bosenova" explosion. This offers new insights for quantum simulation and many-body physics research.