Ultracold Big Bang Experiment Successfully Simulates Evolution of Early Universe

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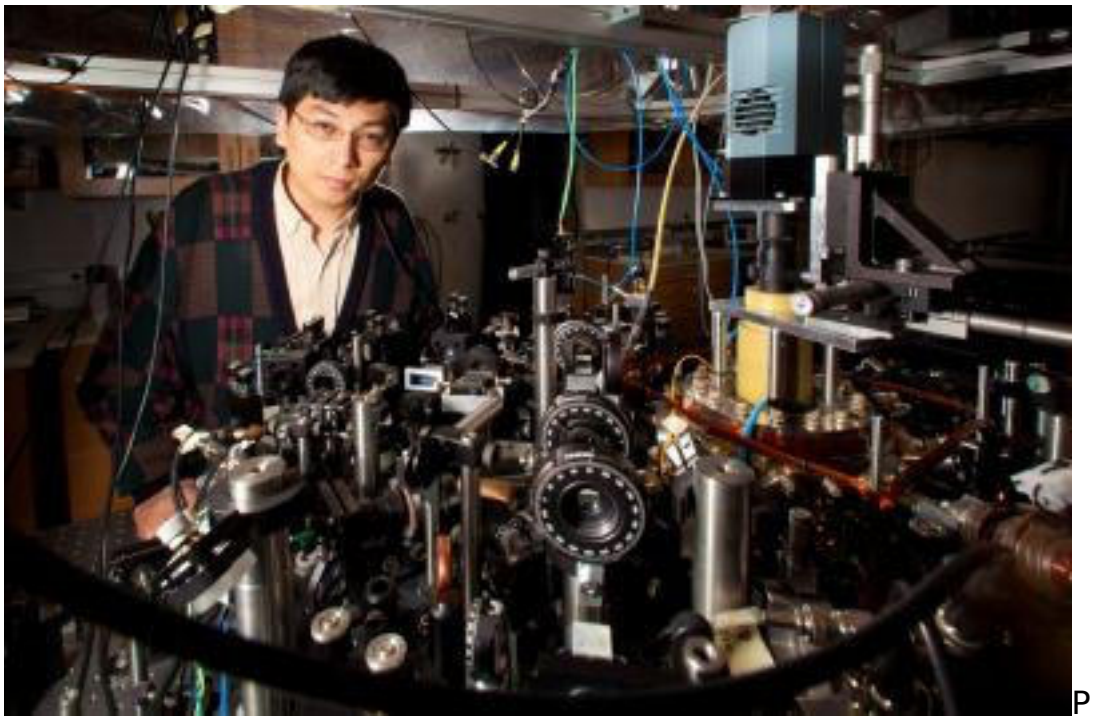

Physicists have reproduced a pattern resembling the cosmic microwave background radiation in a laboratory simulation of the big bang, using ultracold cesium atoms in a vacuum chamber at the University of Chicago [1].

"This is the first time an experiment like this has simulated the evolution of structure in the early universe," said Cheng Chin, professor in physics. Chin and his associates reported their feat in the Aug. 1 edition of Science Express, and it will appear soon in the print edition of Science.

Chin pursued the project with lead author Chen-Lung Hung, PhD'11, now at the California Institute of Technology, and Victor Gurarie of the University of Colorado, Boulder. Their goal was to harness ultracold atoms for simulations of the big bang to better understand how structure evolved in the infant universe.

The cosmic microwave background is the echo of the big bang. Extensive measurements of the CMB have come from the orbiting Cosmic Background Explorer in the 1990s, and later by the Wilkinson Microwave Anisotropy Probe and various ground-based observatories, including the UChicago-led South Pole Telescope collaboration. These tools have provided cosmologists with a snapshot of how the universe appeared approximately 380,000 years following the Big Bang, which marked the beginning of the universe.

It turns out that under certain conditions, a cloud of atoms chilled to a billionth of a

degree above absolute zero (-459.67 degrees Fahrenheit) in a vacuum chamber displays phenomena similar to those that unfolded following the big bang, Hung said.

"At this ultracold temperature, atoms get excited collectively. They act as if they are sound waves in air," he said. The dense package of matter and radiation that existed in the very early universe generated similar sound-wave excitations, as revealed by COBE, WMAP and the other experiments.

The synchronized generation of sound waves correlates with cosmologists' speculations about inflation in the early universe. "Inflation set out the initial conditions for the early universe to create similar sound waves in the cosmic fluid formed by matter and radiation," Hung said.

For more information visit www.uchicago.edu/ [1]

Click here to read the full article [2].

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