Universal, primordial magnetic fields discovered in deep space

September 21 2010

NASA artist's conception of an "active galactic nucleus"

Scientists from the California Institute of Technology and UCLA have discovered evidence of "universal ubiquitous magnetic fields" that have permeated deep space between galaxies since the time of the Big Bang.

Caltech physicist Shin'ichiro Ando and Alexander Kusenko, a professor of physics and astronomy at UCLA, report the discovery in a paper to be published in an upcoming issue of Astrophysical Journal Letters; the research is currently available online.

Ando and Kusenko studied images of the most powerful objects in the universe -- supermassive black holes that emit high-energy radiation as they devour stars in distant galaxies — obtained by NASA's Fermi

Gamma-ray Space Telescope.

"We found the signs of primordial magnetic fields in deep space between galaxies," Ando said.

Physicists have hypothesized for many years that a universal magnetic field should permeate deep space between galaxies, but there was no way to observe it or measure it until now.

The physicists produced a composite image of 170 giant black holes and discovered that the images were not as sharp as expected.

"Because space is filled with background radiation left over from the Big Bang, as well as emitted from galaxies, high-energy photons emitted by a distant source can interact with the background photons and convert into electron-positron pairs, which interact in their turn and convert back into a group of photons somewhat later," said Kusenko, who is also a senior scientist at the University of Tokyo's Institute for Physics and Mathematics of the Universe.

"While this process by itself does not blur the image significantly, even a small magnetic field along the way can deflect the electrons and positrons, making the image fuzzy," he said.

From such blurred images, the researchers found that the average magnetic field had a "femto-Gauss" strength, just one-quadrillionth of the Earth's magnetic field. The universal magnetic fields may have formed in the early universe shortly after the Big Bang, long before stars and galaxies formed, Ando and Kusenko said.

Provided by University of California -- Los Angeles