Professor and science writer

Seeking the Lost Seeds of Big Bang

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The space shuttle Endeavour's final mission was remarkable in many ways. It was commanded by astronaut Mark Kelly, the husband of congresswoman and one of the Arizona shooting victims Gabrielle Giffords. Besides that, it carried one of the most expensive payloads to the international space station -- a $2 billion detector called Alpha Magnetic Spectrometer (AMS-02). The main goal of this experiment is to probe the unknown universe by searching for antimatter particles.

The history of antimatter begins with the physicist Paul Dirac whose work in the late 1920s established the fact that for every particle there is a corresponding antiparticle, exactly matching the particle but with opposite charge. If normal matter is formed by electrons, protons and neutrons, antimatter is composed of antiparticles such as positrons (antielectrons), antiprotons and antineutrons. In his Nobel Lecture, Dirac hypothesized the existence of totally new stars, galaxies and even a universe made out of antimatter.

The above mentioned antiparticles have been experimentally detected by 1960s. Since then, scientists have been trying to create and trap the antimatter atoms with improved techniques. Most recently, a collaboration of scientists at the CERN particle physics laboratory have reported the confinement of antihydrogen atoms for more than 15 minutes in a magnetic trap.This would enable the researchers to probe the behavior of this exotic matter. (In normal hydrogen atom an electron is bound to a proton, but in antihydrogen atom an antielectron (positron) is bound to an antiproton.)

Physicists believe an asymmetry that occurred in the early universe is the root cause of everything including our own existence. Theories suggest that equal amount of matter and antimatter should have been created at the Big Bang. When they interact, both matter and antimatter completely annihilate each other in a flash of radiation. However, in the early universe, matter somehow dominated the antimatter giving way to a universe filled with stars planets and galaxies.

The victory of matter over antimatter is a mystery. Where has the anti-matter gone? Does a mirror image of our universe exist that's made of antimatter? Could there be isolated systems of antimatter in the universe? We don't have definitive answers to these questions at this point.

Though the laboratory experiments created antimatter particles and atoms in small quantities, cosmologists remain speculative about their large presence in the universe as Paul Dirac imagined. AMS, now installed on the long arm of the International Space Station (ISS) will collect the data to find these lost seeds of Big Bang, if there are any left!

"Whether or not there is significant antimatter is one of the fundamental questions of the origin and nature of the universe. Any observations of an antihelium nucleus would provide evidence for the existence of antimatter", writes Nobel laureate Samuel Ting of MIT, who is the principal investigator of the project.

Antimatter particles, born out of equations and imagination, once again illustrate that human imagination is the most vital element of success. Once thought to be a theoretical particle, the positron has already found its way to practical

world. The brain scanning procedure known as PET (Positron Emission Tomography) exploits the electron-positron annihilation to reveal the workings of the brain. The positrons created by the radioactive decay process are used to annihilate electrons in the atom of the brain, rendering an image of the brain on the screen. Researchers are optimistic about the use of antiproton in tumor irradiation in the future.

Seeking the pulse of antimatter is a challenging journey. It's also a tribute to the invocation by Paul Dirac, "Pick a flower on Earth and you move the farthest star."