ASTRONOMY

Nobel laureates' work reaches back to Big Bang

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Recently, I was asked about this year's Nobel Prize in physics. The descriptions my friend had read in the newspaper and heard on the radio were vague and didn't seem to explain why this science is important.

Actually, the discoveries made by this year's Nobel laureates are very important, in part because they touch on why we exist. To explain this, let's first talk about matter and antimatter.

Matter is the stuff all around us -- protons, neutrons and electrons. Antimatter is the mathematical opposite of matter, and can be produced by, say, causing two particles to collide at high energy. When antimatter touches matter, both are annihilated, giving off pure energy.

In the Big Bang theory of the universe, the laws of physics say that equal numbers of particles and antiparticles should have been created. In other words, the universe started out in a "symmetric" state of matter and antimatter.

Of course, equal amounts of matter and antimatter could annihilate each other, leaving nothing.

Astronomical observations tell us that all celestial objects are made of matter. So what happened to the antimatter? Evidence, in part from cosmic microwaves, shows that more than 99.99 percent of all matter and antimatter have been annihilated, leaving only a small fraction of matter. That is the stuff of the stars, sun and Earth. A very small asymmetry in the laws of physics could account for the excess matter.

This is precisely what the Nobel laureates discovered.

Makoto Kobayashi and Toshihide Maskawa discovered the theoretical mechanism for "symmetry breaking," leading to a small excess of matter. The other laureate, Yoichiro Nambu, formulated the basic mathematics of symmetry breaking.

However, the problem is not yet solved. Symmetry breaking is not big enough to account for the amount of matter in our universe. But it does pave the way for a future understanding of the matter-antimatter asymmetry.

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