PHYSICS

Ashes of the Universe

➤ NEUTRINOS, "ghost" particles of the atomic nucleus, are the ashes of the universe, the American Physical Society was told in New York.

Neutrinos were also probably the original stuff from which the universe was created if the "big bang" theory of the origin of the cosmos holds true.

The universe will eventually dissipate most of its usable energy in the form of neutrinos, which are massless, chargeless particles. They interact so rarely with matter that a neutrino can penetrate ten billion earths.

Although the sun sends out neutrinos at such a rate that 200 billion of them bombard each square inch of the earth each second, a human absorbs only one neutrino in his lifetime. Most of the solar neutrinos come from the burning of hydrogen into helium, a process similar to the reactions inside a hydrogen bomb.

Dr. Hong-Yee Chiu of the National Aeronautics and Space Administration's Institute for Space Studies, New York, and Yale University said that, on the average, one-fifth of the total energy radiated by a star in its lifetime is in the form of neutrinos, according to a new theory.

His studies have shown that neutrinos are influential in determining the evolution of stars more massive than the sun when they are in their later stages. The sun, Dr. Chiu said, is on the border line between stars of a size that might be affected by neutrino production and those too small. It would take about a box car filled with detectors to pick up direct evidence for solar neutrinos. However, experiments are under way at Brookhaven National Laboratory to try to detect man-made neutrinos.

Previously it was thought that the radiation of light was the principal process by which stars lost energy. Recent developments in elementary particle physics, when applied to stellar interiors, show the importance of neutrinos in energy dissipation.

The process for neutrino production is known as the annihilation process: the star loses energy by creating an electron and positron pair that subsequently annihilate into a pair of neutrinos. The neutrinos then leave the star, carrying energy away.

In normal stars, Dr. Chiu reported, this neutrino process is not the most important process. However, in some stars, where elements such as iron are being formed by the fusion of hydrogen or helium, the neutrino process is very important. It shortens the time needed for element synthesis from millions of years to thousands of years.

Dr. Chiu noted that this new time duration is more consistent with the observed abundance of elements found on earth. When the star's temperature reaches six to seven billion degrees, the neutrino emission process causes the star to explode as a supernova.

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PHYSICS

"Wiggleworm Scientists"

➤ IF SUCH a blind, deaf, highly intelligent animal as a "wiggleworm" actually existed, it would eventually learn to view the world in much the same way as humans, even though it developed very differently.

Dr. Jerome Rothstein of Maser Optics, Inc., Boston, presented this report to the American Physical Society meeting in New York. He studied the theoretical development of wiggleworms to determine how much of the way man looks at the universe is influenced by his means of perceiving it.

Humans are basically eye and hand coordinated. This could fool us into believing that the universe must have some particular structure, when, in reality, the picture is "warped by being filtered" through the human sensory and nervous equipment.

To test this theory, Dr. Rothstein devised a race of blind, deaf, highly intelligent worms living in black, cold, sea-bottom mud. He calls his hypothetical creatures "wiggleworms." They possess only senses of touch, temperature and a kind of taste because of a chemical sense.

The "wiggleworms" were chosen because they seemed to be about as different from human beings as they could possibly be and still be able to learn things about their environment. They have no eyes, ears or hands. They cannot use the sun or the stars to give them notions of time. They do not have natural rulers a "foot" in length because they have no feet.

In plotting the wiggleworm's development, Dr. Rothstein imposed the rule that the only concepts the worms can use are those that develop by thinking about the experiences available to them. He finds that the worms would develop the idea of the three dimensions of space plus one of time. Their elementary geometry would not be like that taught in human schools but rather the advanced field called topology.

The worms' temperature and chemical senses would make thermodynamics an elementary subject for them, whereas mechanics could only be reached after long and arduous research. The settling of objects in water or in ooze could ultimately lead them to discover the laws of mechanics and gravitation.

"One can imagine the courage and ingenuity the worms would have to display in order to learn of conditions in the water above them, particularly with predatory fish ready to gobble them up as soon as they pop out of the ooze," Dr. Rothstein said.

Human exploration of space would be "child's play" compared to the epic story of how these worms might eventually navigate in the water safely, using shells with gas bubbles trapped in them to rise to the surface. Their conquest of dry land in water-containing "space ships" and their discovery of the stars would be a tale of heroic exploration and scientific ingenuity humans would find it hard to match, Dr. Rothstein reported.

He concluded that there "is no good reason to believe that advanced wiggleworm physics would ultimately be much different than advanced human physics." Therefore, humans are not being fooled in their view of the world.

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