

## **Subject: Sermon Ideas -- Dark Matter, Energy Puzzling Astronomers**

*Many questions, no answers.*

Have we just found God? When you read this, recall your physical definition of God. If one actually tried to see God face to face, what would one be looking for?

John Speight

### **Dark Matter, Energy Puzzling Astronomers**

**by Paul Recer, AP Science Writer**

Thu Jun 19, 8:00 PM ET

Washington - The Earth, moon, sun and all visible stars in the sky make up less than one percent of the universe. Almost all the rest is dark matter and dark energy, unknown forces that puzzle astronomers.

Observations in recent years have changed the basic understanding of how the universe evolved and have emphasized for astronomers how little is known about the major forces and substances that shaped our world.

Astronomers now know that luminous matter — stars, planets and hot gas — account for only about 0.4 percent of the universe. Nonluminous components, such as black holes and intergalactic gas, make up 3.6 percent. The rest is either dark matter, about 23 percent, or dark energy, about 73 percent.

Dark matter, sometimes called "cold dark matter," has been known for some time. Only recently have researchers come to understand the pivotal role it played in the formation of stars, planets and even people.

"We owe our very existence to dark matter," said Paul Steinhardt, a physicist at Princeton University and a co-author of a review on dark matter appearing this week in the journal *Science*.

Steinhardt said it is believed that following the Big Bang, the theoretical beginning of the universe, dark matter caused particles to clump together. That set up the gravitation processes that led to the formation of stars and galaxies. Those stars, in turn, created

the basic chemicals, such as carbon and iron, that were fundamental to the evolution of life.

"Dark matter dominated the formation of structure in the early universe," Steinhardt said. "For the first few billion years dark matter contained most of the mass of the universe. You can think of ordinary matter as a froth on an ocean of dark matter. The dark matter clumps and the ordinary matter falls into it. That led to the formation of the stars and galaxies."

Without dark matter, "there would be virtually no structures in the universe," he said.

The nature of dark matter is unknown. It cannot be seen or detected directly. Astronomers know it is there because of its effect on celestial objects than can be seen and measured.

But the most dominating force of all in the universe is called dark energy, a recently proven power that astronomers say is causing the galaxies in the universe to separate at a faster and faster speed. It is the force that is causing the universe to expand at an accelerating rate.

Robert P. Kirshner, an astronomer at the Harvard-Smithsonian Center for Astrophysics, said the presence of dark energy was proved only five years ago when astronomers studying very distant exploding stars discovered they were moving away at a constant acceleration. It was a stunning discovery that has since been proved by other observations.

Kirshner said it is clear now that dark matter and dark energy engaged in a gravitational tug of war that, eventually, dark energy won.

Following the Big Bang some 14 billion years ago, matter in the universe streaked outward. It formed galaxies, thinned out and then began to slow down.

"Dark matter was trying to slow things down and dark energy was trying to speed it up," said Kirshner, the author of a review article on dark energy in *Science*.

"We think dark matter was winning for the first seven billion years, but then universe went from slowing down to speeding up. ... Dark energy took over."

Kirshner said astronomers do not really understand dark energy. Albert Einstein first proposed a form of the idea, but discarded it later. Now, researchers know it exists, but its exact form and nature are mysterious, although it is thought to be related to gravity.

"What this is pointing to is a deep mystery at the heart of physics," said Kirshner. "We don't understand gravity in the same way we understand other forces."

He said there are virtually no experiments on Earth that would explore the nature of dark energy. It can only be studied across vast stellar distances by observing the motion of

objects extremely far away, a skill that has been possible only in recent decades with the development of very powerful telescopes.

"Dark energy will cause the universe to expanded faster and faster and eventually, over time, we will see less and less of it," Kirshner said. Over millions of years, familiar stars and nearby galaxies will disappear from view and the sky, now choked with stars, will slowly darken.

"The piece of the universe that we can see will get lonelier and lonelier," he said.