

Early universe was filled by bright, invisible light

By MARSHALL BURNS

Science Columnist

"In the beginning ... the world was formless and void and darkness was over the surface of the deep.... Then God said 'Let there be light;' and there was light."

So begins Genesis, the ancient Hebrew story of creation. Considering what they had to work with, it seems amazing how close the tellers of that tale came to a rough description of today's scientific understanding of the early universe.

When Einstein developed the general theory of relativity between 1905 and 1916, he invented the first tools that allowed people to actually calculate the behavior of the universe itself. The "Big Bang" theory, which hypothesizes that the universe has grown out of an original explosion some 10 billion years ago, is a simple mathematical consequence of Einstein's theory.

In those early days, if this theory is right, the universe was indeed formless. Space was a thick, hot soup of the same elementary particles that would later form atoms. But, at that time, the soup was too hot for an atom to hold itself together.

Protons, neutrons, electrons, and other types of matter floated around together. Along with matter there were other constituents, including one very familiar today: light. Every corner of the universe was ablaze with the brightest light you could ever imagine.

With all that light around, were the Genesis story-tellers off the mark when they talked about a dark beginning? Not if by "darkness" they meant that you couldn't see anything.

Although we find light to be useful because we have eyes which are sensitive to it, light plays a more fundamental role in the universe than making vision possible. Light is electromagnetic interaction, that is, it is the interaction among things that are electrically charged.

physics watch

'And matter said "Let's make atoms;" and there was light.'

In today's universe, almost everything is made out of atoms, which are electrically neutral. Light can travel a hundred million miles from the sun to the Earth, or it can travel a few feet from the light bulbs in your room to the pages of this newspaper, before running into a charged object to interact with.

In the thick soup of the early universe, however, the major ingredients were individual protons and electrons, which are electrically charged. In those days, a particle of light couldn't go as far as an inch without disappearing into an interaction with a charged particle.

In the early universe, you literally would not have seen the nose on the front of your face. So while the universe was filled with extremely bright light, it was at the same time totally dark. This was how things were for about the first 100,000 years of time.

This situation changed as the universe grew older and larger, and became less energetic.

As the universe cooled down, protons and electrons began to pair up and form hydrogen atoms. The new atoms were electrically neutral. For the first time, light began to travel vast distances. Vision became possible.

If a modern-day prophet were to rewrite the Old Testament, it might start off something like this: "In the beginning the world was formless and hot and a bright darkness filled the deep. And matter said 'Let's make atoms;' and there was light."