Program of Dialogue on Science, Ethics, and Religion

Evidence and Cosmology: What We Have Learned from NASA's Cosmic Radiation Probe

By Rebecca Booker

This past year the WMAP (the Wilkinson Microwave Anisotropy Probe), NASA's cosmic radiation probe, provided significant new support for standard Big Bang cosmology and its inflationary model. This prompted *Science* magazine to declare the probe finding the "2003 Breakthrough of the Year". As the WMAP continues to send new information about our Universe, and as new, better probes are launched, what we learn about our Universe's past could give us insights into its future.

Dr. Michael Turner, Assistant Director for Math and Physical Sciences at the National Science Foundation, presented the WMAP findings at a February 19, 2004, lecture sponsored by the Program of Dialogue on Science, Ethics and Religion, a program of the American Association for the Advancement of Science (AAAS). The Reverend Barbara Putney Smith-Moran offered a response to his lecture that considered the theological implications of the origins of the Universe and evolution of life. Rev. Smith-Moran has earned three masters degrees: in biology and chemistry from Johns Hopkins, in astronomy from Harvard, and in theology from the Episcopal Divinity School in Cambridge, MA.

WMAP images provide a look backward in time. "As you look out in space, you look back in time," Turner explained. "You're looking back to a time when galaxies were being born. If you look back any farther, you're looking back to a time before galaxies. If you go forward in time you can see the Universe getting bigger. If you go backward in time, maybe ten billion years, the galaxies are closer."

When the Universe was 10^{-43} seconds old, it was a trillion times smaller than it is now. At this time it was made up of quarks, along with the leptons the most fundamental elements of matter. As the Universe expanded, it cooled. When the Universe was a microsecond old, the quarks were cool enough to bond, forming neutrons and protons. Within a few minutes of the Big Bang, the Universe was cool enough for the neutrons and protons to form nuclei of the lightest elements of the periodic table: hydrogen, helium and lithium. When the Universe was about three hundred thousand years old, it cooled enough for the nuclei to capture electrons and make atoms. The first large-scale structures, the first stars, did not form until the Universe was about a billion years old. The microwave photons captured by the WMAP, come from when the Universe was four hundred thousand years old, far before the formation of the galaxies, at the very beginning stages of matter.

The mission of the WMAP was to provide a finer resolution of small variations of temperature in the cosmic background radiation that had been discovered by the earlier COBE (Cosmic Background Explorer) satellite. The difference in intensity captured by the WMAP is an indication of a very slight lumpiness of matter in the very early universe. These variations, Turner reminded, are differences of thirty-millionths of a degree. “The Universe was almost uniform mush,” Turner said.

It is from these miniscule lumps, Turner said, that scientists have gleaned information that bears on determinations of the size, shape and age of the Universe. We have learned, for example, that the Universe is 13.7 billion years old, with an error of plus or minus 1 percent.

Combined with other observations the WMAP data also tells us of what our Universe is comprised. We learn we live in a Universe made up of only 4% of ordinary matter. 23% is what is called cold, dark matter and the remaining 73% of the Universe is what is called dark energy.

It is theorized that a burst of inflation immediately following the Big Bang causing all the quantum fluctuations that were present in the very beginnings of the Universe to get

stretched to millions of light years. If this pattern is correct, Turner said, the cold and hot spots in the cosmic background radiation corresponding to regions with density slightly lesser or higher, are actually quantum fluctuations manifest in the macroscopic world. The present WMAP universe, in this case, is actually the quantum world stretched by inflation and projected on the sky. “If this explanation is right,” Turner said, “it is really the ultimate connection between the small and the big.”

“We are getting to the place in cosmology where we can say this is not just a convenient way to describe the history of the Universe and what happened today, but we have scientific evidence that this actually happened.”

The Reverend Barbara Putney Smith-Moran responded to the lecture, reminding the audience that “religion, in part, is the practice of finding or assigning purpose or meaning, discovering it or making it.”

In its simplest form, this can be seeing the likeness of Christ or the Virgin in the grain of wood paneling. On a grander scale, we have come to find meaning in the events of human history, such as the escape of the Hebrew slaves from the Egyptians. “Now we want to find meaning and purpose even in the deepest past, in the deepest history of the cosmos that we can detect. This is important to all of us whether we define ourselves as religious or not,” Smith-Moran said.

Referencing the WMAP image, an echo of the deepest past of the Universe, Smith-Moran said, “We don’t know why it has the properties that led to life, but when we look at this Universe here, we know for certain that it did. We can look at this picture and shout, ‘Grandma!’”

It is arrogant, she said, to presume that God is not creating miracles in the lives or events of histories other than our own. “You are always on shaky ground to presume that your own criteria are universal. It becomes more difficult to ascertain what God was doing before life developed,” she said.

This God of the beginnings of the universe, which she described as a proto-God, eventually evolved into our God, the God of human beings. This concept has support in the scientific concept of co-evolution, many examples of which are found in nature. Perhaps, Smith-Moran suggested, it might be the case that God and humans co-evolved. God grew up with us and formed us, even as we were forming God.

"Could it be possible that their relationship today is the result of long-term cooperation that started out between proto-humans and proto-God?" she asked. "If we can look at the WMAP photo and say 'Grandma!' then so can our God."

Interaction within physics has brought about several revolutions in astrophysics, Smith-Moran asserted. The same can be said for the interaction of astrophysics and religion. Groundbreaking scientific discoveries about the cosmos influence religious understanding, and this is happening more and more as science and religion continue to interact.

Quoting French Muslim astrophysicist Bruno Guiderdoni, she said: "In this image will be written the sheer power of the laws that have moved the Universe. The same picture will also reveal the gentleness that has allowed structure to develop; the formation of the galaxies and, in due course, our own existence. The might of God and the subtly of humankind will be gathered into a single image. This new icon will be circulated in the first years of the new millennium. By reflecting upon this illuminate image, we should be reminded, even as the astronauts of Apollo 8 reminded us, that the earth is lost in dark space, this darkness is not inhospitable. In the most distant sky are kept the laws that provide us with this teaching."