

Uncertainty on the Grandest Scale

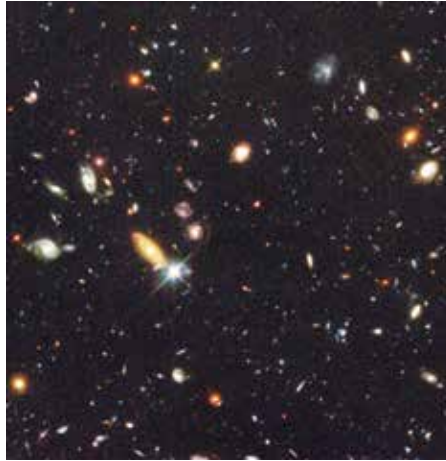


Donald G. Rockwell

I am committed to devote at least one of my President's Page columns to a true interest of mine: astrophysics. Some of you may know that my undergraduate major was physics. I grew up with a father who was something of an amateur astronomer. He had a four-inch diameter Newtonian telescope and subscribed to *Sky and Telescope* magazine. I have great memories spending time with my father looking at the night sky through his telescope and reading his astronomy magazines. My strong sense of curiosity has flourished in astronomy. I will always be fascinated about the scope and breadth of our solar system, galaxy, and universe.

As I grew older and witnessed accelerating changes in the world around me, I found the sky and its many objects comforting for their seemingly total absence of change. The stars and nebulae were in the same place every night, and I found peacefulness in their stable presence.

Then the Hubble Space Telescope was launched in 1990 and took perhaps its most famous photo over a 10-day period in 1995—the so-called Hubble Deep Field (HDF) photo seen on this page. I was totally amazed then and still am now when I look



Hubble Deep Field (1995)

at it framed and hanging on my office wall. I look at it often with philosophical interest, knowing that our world is such a small part of something incomprehensibly large.¹

The HDF photo includes an area of the sky near our north star, Polaris—an area so small it can be covered by a *quarter* grain of sand held at arm's length from one's eye. Yet this photo contains images of approximately 500 galaxies, some as distant as 13 billion light years away where galaxies formed within 1 billion years after the Big Bang. The world saw for the first time just how immense our universe was from a clear photo taken of its very horizon. The HDF photo data has been described as the astronomical equivalent to the Dead Sea Scrolls for research about the structure and evolution of the universe.

But all of this is not what is most interesting to me about the HDF photo. In 1995, astrophysicists were strongly suspicious that a good portion of what is contained in photos like the HDF could not actually be seen. Since the mid-twentieth century, scientists believed from the way stars orbited within galaxies that their orbits could only be explained by the presence of invisible

matter *in addition* to the ordinary (baryonic) matter that could be seen. This additional matter was called “dark matter” and it was thought to comprise 25 percent of all matter-energy in the universe.

Further complicating things was a monumentally surprising discovery made in 1998 by using the same Hubble Telescope, this time looking at star explosions (supernovae) in very distant galaxies. The universe was determined to be expanding in an *accelerating* fashion caused by what is now called “dark energy.” This dark energy is thought to contain 70 percent of the matter-energy of the universe.

In other words, the dark matter and dark energy that we *cannot* see directly in the HDF photo makes up 95 percent of everything actually contained in the photo—we see only five percent of what is really there.

To make things more fascinating, no one—not even the very brightest minds—knows what dark matter or dark energy even is.

So every time I think about how our world is becoming more uncertain and how almost every aspect of our lives is being subjected to changes that are accelerating as time goes by, I look at the HDF photo hanging in my office and contemplate that not one person among the very brightest minds in the world has a clue as to what makes up 95 percent of our universe!²

If you think we lawyers are witnessing uncertainty, think of astrophysicists who cannot even explain 95 percent of what is around us. We all live in most interesting times. ■

ENDNOTES

1. Whenever I am stressed or having a bad day, I look at the HDF photo and tell myself that absolutely no one in the photo cares about my problems.
2. This is also a reminder to me that intelligence can be defined not as to what we know but, rather, the recognition of what we do not know.

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