The New York Times | http://nyti.ms/1tEVbHN

SCIENCE

Much-Discussed Views That Go Way Back

Avi Loeb Ponders the Early Universe, Nature and Life

DEC. 1, 2014

Claudia Dreifus

A CONVERSATION WITH

CAMBRIDGE, Mass. — Among astrophysicists, Abraham Loeb is known for his creative and prolific attempts to understand the early universe.

Dr. Loeb, known as Avi, specializes in 400,000 years to one billion years after the Big Bang. He has published more than 400 papers on the nature of early stars, galaxies, planets and black holes.

"Avi is very good at picking problems to work on that have testable results," said Robert Wilson, who received the Nobel Prize in Physics (with Arno Penzias) for discovering cosmic microwave background radiation, thought to be a remnant of the Big Bang.

I spoke with Dr. Loeb, 52, in his office here at Harvard, where he is the chairman of the astronomy department, and then later by telephone.

Here is an edited and condensed version of our conversations.

Q. WHY DID YOU CHOOSE THE EARLY UNIVERSE AS YOUR AREA OF STUDY?

A. Because I like to work where there's no crowd. One of the great pleasures of astrophysics is trying figure out something about the universe that nobody else has.

When I first came to Harvard, about 20 years ago, I was attracted to the question of how and when did the first stars and galaxies form, because this was something that we really didn't know much about. The only thing we knew was

related to the cosmic microwave background radiation which originated about 400,000 years after the Big Bang.

We also knew that the galaxies and the stars didn't always exist. So the question was, when did they form?

Over the years, I've helped develop tools to image and map what happened. I've done calculations and suggested to observational astronomers ways to approach this era. I've developed a technique to image the universe in three dimensions that relates to the times when galaxies were formed, and I helped develop tests so that we can detect previously unknown galaxies and black holes. I also developed a test which will hopefully permit us to see the expansion of the universe in real time.

It will be loaded onto the James Webb Space Telescope, which is scheduled to be launched in 2018. This should produce new insights. So this once lonely field has gotten crowded. It may be time to do other things.

LAST YEAR YOU PUBLISHED AN ASTONISHING PAPER SUGGESTING THAT SOME TYPE OF LIFE MIGHT HAVE BEEN POSSIBLE IN THE EARLY UNIVERSE, BILLIONS OF YEARS BEFORE IT APPEARED ON EARTH. WHERE DID THIS COME FROM?

On Thanksgiving morning, I had this realization: that at the time the first stars and galaxies were formed, the cosmic microwave background — the radiation left over from the earliest time — was roughly at room temperature. So the universe, at roughly 15 million years after the Big Bang, was at a comfortable enough temperature for the chemistry of life to have incubated.

I realized this while in the shower — as often happens. We had guests coming in the afternoon. So I asked my wife if instead of helping her with the meal, I could take care of the dishes after dinner. That gave me a few free hours to think this out.

What it came down to was that if there had been planets that early, they could have been warmed by the cosmic microwave background. They didn't need to be warmed by a star. And so the chemistry of life could have started that early.

After I finished working this out, I posted a draft of my paper on arXiv.org, a server where astrophysicists upload writings for feedback from colleagues. To my surprise, journalists also looked at it. Immediately, the phone rang. The paper ended up receiving a lot of media attention.

WHAT DO YOU MAKE OF THAT?

People are interested. Historically, cosmology has described the universe as full of lifeless objects. That may be a misconception. It may be that the universe is teeming with life. The problem is that life does not produce a lot of energy and it's hard to detect.

I've been curious about how this limits us in the search for life. Suppose there is an extraterrestrial civilization on a planet near a star not far from us, and suppose there was a nuclear war there. Could we see it with our telescopes? Turns out that even with the most powerful of contemporary telescopes, we couldn't see the flare.

However, there are ideas and techniques for detecting more subtle signatures — for example, radio signals.

YOU ONCE PUBLISHED A PAPER SUGGESTING THAT IF WE'RE SERIOUS ABOUT LOOKING FOR EXTRATERRESTRIAL LIFE, WE MIGHT SEEK OUT MARKERS OF INDUSTRIALIZATION, LIKE SMOG. SMOG?

Yes, smog might serve as a fingerprint of an industrial civilization. It's always been thought that the way to detect life elsewhere was to look for signs of oxygen. But intelligent life could produce unnatural molecules. They might do that intentionally if their planet was too cold for life. Unnatural molecules might even show signs of a civilization that may not exist anymore because unnatural molecules can survive long after a civilization.

SOME OF YOUR WORK SOUNDS ALMOST LIKE SCIENCE FICTION. WHERE DO YOU DRAW THE LINE?

It's not that. Nature has richness beyond our imagination. What I look for are interesting astrophysics questions that are provable. Though my research may ask unconventional questions, the answers are based on calculations, experiments and observations.

DID YOU ALWAYS WANT TO BE AN ASTROPHYSICIST?

At a young age, I was attracted to philosophy because it asked the most interesting questions. But then, at 18, I had to do my military service in Israel, where I grew up. After some testing, I was allowed to join a special program where you could work on projects useful for the defense of the country. I ended up doing research in plasma physics. And because of that, I was able to visit the United States in the 1980s.

During one of these trips, I visited the Institute for Advanced Study. A month later, I was offered the opportunity to do a postdoc there. There was one condition, though: I had to switch to astrophysics. That appealed because it was like returning to an old love — philosophy. In astrophysics, I could address very big questions about nature and life.

IN YOUR STUDIES OF THE EARLY UNIVERSE, YOU RUN SMACK AGAINST THE IDEAS OF THE BOOK OF GENESIS. HOW DO YOU DEAL WITH THAT?

The first chapter of the Bible states that there was a beginning in time. Science shows that we live in an expanding universe, and if you extrapolate, there was a point in time in when things began. In some ways, they are consistent.

IS IT POSSIBLE FOR AN ASTROPHYSICIST TO BE RELIGIOUS?

It really depends on what you mean by "God." Spinoza would feel very comfortable with modern science because in his philosophy, God is nature. That pretty much summarizes Einstein's view, too. So if you're defining God in a way that identifies the laws of nature with his or her qualities, that's perfectly consistent. But if you attribute parts of reality to God in a way that cannot be understood by rational thinking, a conflict emerges.

HOW DO YOU HANDLE THE VAST QUANTITIES OF TIME AND SPACE THAT YOU MUST NAVIGATE TO DO YOUR WORK? DO YOU, AS IN THAT OLD KURT WEILL SONG, EVER FEEL LOST IN THE STARS?

Personally, I do not feel lost in the stars, but rather at home with all of them. When I look at the stars of the Milky Way on a clear night, they appear to me like the lights of a giant spaceship streaming through the universe.

Are there any passengers around the other lights in this spaceship? It would be fun to know and perhaps, share experiences with them.

A version of this interview appears in print on December 2, 2014, on page D2 of the New York edition with the headline: Much-Discussed Views That Go Way Back.
