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Star struck

Studying the chemistry of distant stars offers tantalizing clues to our origins

Venn

by Jessica Gillies

University of Victoria astronomer Kim Venn is looking billions of kilometres into space to solve the mysteries of life here on Earth.

Venn studies how the universe formed and evolved. All the chemical elements—the building blocks of matter—that exist in the universe had to come from somewhere, and Venn wants to know how and when they were created.

"Our sun formed out of material that was eight billion years in the making," she says. "Was that special? Did the chemistry in our galaxy have to be just right in order to make the sun, or to make a planet like the Earth habitable?"

By studying stars of different ages, Venn can reconstruct the formation of the elements that make up our world and help answer the question of how we came into being.

After the Big Bang that created the universe 13.7 billion years ago, only four basic elements existed: hydrogen, helium, lithium and beryllium. All the elements we know today have evolved since then within stars in individual galaxies.

Some elements can be formed in multiple ways in stars. Astronomers can figure out which processes took place by studying relative amounts of the different elements that formed. They determine which chemicals are present in a star by analysing its light spectrum.

Some of Venn's recent research focuses on stars that formed during the first million years after the Big Bang, called "first stars." Something strange and unknown happened during that time period, she says, because those "first stars" had no metals in them. Furthermore, we don't see any stars like that in the galaxy today, even though we should.

Once Venn and others learn more about that time period, they'll be able to fill in a missing piece of the timeline and trace the evolution of elements from the Big Bang to the present.

Venn is fascinated by the serendipitous chemical reactions in the universe that led to our existence. Carbon, for example, is the basis of all life on Earth, but its original creation in the universe was such an unlikely event.

In the core of some stars, helium burns in a way that creates an atom called beryllium-8, a very unstable form of beryllium (a rare metal). Because it's so unstable, beryllium-8 usually breaks down into helium almost instantaneously.

But sometimes, the beryllium-8 atom comes into contact with another helium atom that has just the right energy resonance—the amount of energy an atom needs to combine with other atoms—to form carbon.

"We think it's straightforward to make all the other chemical elements once carbon is made," says Venn. "Life, as we know it, exists because beryllium-8 happens to have an energy resonance of eight mega-electron volts, and the temperatures at the cores of stars happen to give helium atoms an energy resonance of eight mega-electron volts. If they didn't, we wouldn't have made it to carbon, and then we wouldn't exist."

"That's so precarious and cool," she says.

EDGEwise

Venn is the Canada Research Chair in Observational Astrophysics. She has been analysing the chemistry of stars for nearly a decade using the Very Large Telescope in Chile, the Hubble Space Telescope and the Keck Telescope in Hawaii, along with their high-resolution optical spectrographs.

Current telescopes allow astronomers to study the chemistry of galaxies within 700,000 light years of our own Milky Way galaxy. Astronomers wanting to study more distant galaxies will have to wait about 10 years for the new 30-metre telescope (TMT) , which will probe 10 billion light years into deep space.

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