By measuring lithium, researchers study star structure

October 25 2012

During its nuclear fusion processes, a burning star does not make the element lithium. Rather, over time, stars consume their lithium supply that was originally created during the Big Bang that gave birth to our universe.

Now, scientists from the University of Kansas are using lithium measurements to better understand stars and star clusters in the Milky Way.

"Lithium is very, very cool as an element for a lot of reasons," said Barbara Anthony-Twarog, professor of physics and astronomy at KU. "In the Big Bang, hydrogen and helium were created when the universe was about three minutes old, along with some other light elements like lithium, beryllium and boron. Everything else gets made inside stars. But lithium doesn't get made further inside stars. It gets chewed up, burned or destroyed. We have this cosmological marker of how much lithium was made long ago. But is it still there inside a star? If not, why not?"

Working with her husband, Bruce Twarog, professor of physics and astronomy at KU, and Con Deliyannis of Indiana University, Anthony-Twarog utilizes a 3.5-meter telescope at the Kitt Peak National Observatory in Arizona and a 4-meter telescope at Cerro Tololo Observatory in Chile. With a spectrograph, the researchers look carefully at wavelengths of light from stars and star clusters within our galaxy to discover how much lithium is present.

"A spectrograph takes light and spreads it out like a prism—but much more spread out—so that we're looking at a very small range of wavelength for features that are kind of like a bar code on a star's spectrum," Anthony-Twarog said. "If you look at the Sun's light through a prism, there are some darker regions. It doesn't look continuous like you think a rainbow should. And those dark regions are evidence of atoms in the star's atmosphere pulling light out of the spectrum that we would otherwise see. So we quantify that subtraction and associate that with a number of lithium atoms or calcium atoms or hydrogen atoms in the star's atmosphere."

But such analysis of stellar wavelengths not only reveals the chemical makeup of the surface of a star, it presents a history of that star going back to its birth and also gives information about the interior of a star.

"Lithium is a diagnostic marker of what's been going on inside a star basically from the time it formed," said Anthony-Twarog. "The more a star has churned itself up inside, the less lithium we see on its surface. It's kind of an integrated marker of how much disruption the star has internalized and mixed to the surface."

Star clusters—groupings of thousands of stars—are particularly useful for analyzing lithium content because the stars that make them up are close to each other in age and distance from Earth.

"The advantage of looking at thousands of stars simultaneously in a cluster is that they all formed under the same conditions," said Anthony-Twarog. "So there are some things we know in common about them. They're about the same distance from us. We believe they formed out of the same kind of gas. So they should have the same chemical properties. If they're a little different in mass, some of them will be a little further along in their evolution than others."

Provided by University of Kansas