'Galaxy fingerprinting' yields new clues about galaxy evolution

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Astronomers are a step closer to understanding the evolution of galaxies, thanks to new research that compares the chemical make-up of distant galaxies to those in our own galactic back yard.

Trystyn Berg, a PhD candidate in physics and astronomy at the University of Victoria, is studying the inner workings of distant galaxies created during the first three billion years of the universe. But how do you study in detail something that is over 50 billion light-years away?

"We can't see individual stars in these galaxies because they're too far away even for the most powerful telescopes," says Berg, who uses a technique that takes advantage of stars releasing their gaseous products

when they explode.

"Stars are the cauldrons of the universe," he explains. "They create the elements we're made of. They consume their fuel and release the products back into the galaxy during supernova explosions."

Depending on the properties of a galaxy, its chemical contents can tell us how the galaxy evolved over time, how many stars it has, and what types of stars it has made. To get this information, researchers look for distant, intense points of light known as quasars that have galaxies in the foreground.

"All of the gas within the galaxy will absorb some of the background quasar light, leaving a fingerprint of which elements are within the galaxy," says Berg. "This chemical fingerprint can give us some very useful clues about the evolutionary history of the galaxy."

Despite a wealth of data collected in this way from distant galaxies over the past decade, no one has done a detailed comparison to what's seen in nearby galaxies. Until now, that is.

Using observations made with the Keck telescope—one of the largest optical telescopes in the world—Berg and collaborators observed 30 distant galaxies, adding to the previous sample of 310 galaxies. With the additional observations, they were able to compare the chemistry in distant galaxies to nearly 2,000 stars within six nearby galaxies, including the Milky Way.

"We found that many of the distant galaxies are similar to low-mass galaxies in our neighborhood," says Berg. "It's incredible to see, in the short time of three billion years, how quickly it took the universe to make the building blocks of the Milky Way system."

Says Berg: "These observations are stepping stones that allow us to tag which early galaxies the stars of modern galaxies came from. We still don't have an understanding of how parts of the Milky Way system formed, and our results now tell us what chemistry to go look for to answer this question."

More information: Berg presented these results at the 2015 meeting of the Canadian Astronomical Society / Société Canadienne d'Astronomie (CASCA) in Hamilton, Ontario (www.physics.mcmaster.ca/casca2015/?page_id=2).

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