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Star search

A UVic astronomer's laboratory is on the other side of the universe

by Valerie Shore

A long time ago in a galaxy far, far away...

Sounds like the introduction to *Star Wars*, doesn't it? It's also a great way to summarize the work of Dr. Sara Ellison, whose scientific curiosity extends far beyond the boundaries of Earth—and into the far reaches of the universe.

Ellison is a UVic astronomer and Canada Research Chair in observational cosmology who studies the chemical evolution of galaxies. "It's a quest to answer the most fundamental question of all," she says. "How did we get from the simple ingredients that came out of the Big Bang to the rich fabric of galaxies and stars we see around us today?"

The Big Bang refers to the massive explosion that scientists believe created the universe more than 13 billion years ago. Over time the universe has expanded and cooled, and galaxies—essentially large cities of stars—were formed. Our own Milky Way galaxy, for example, has tens of billions of stars, including our sun.

It's the distant galaxies that hold special interest for Ellison. "Light from these galaxies was transmitted millions or billions of years ago," she says, "so as we look further and further away it's like taking slices through the history of the universe."

But the further away a galaxy is, the fainter it looks through even the most powerful telescopes. To get beyond that problem—literally—Ellison looks to the edge of the observable universe for intense points of light, known as quasars.

"The light from these quasars has to travel far to get to me and my telescope, so the chances are it will go through a galaxy along the way," she explains. "If that happens, then some of the light will interact with the various gases in that galaxy."

By studying the spectrum of the quasar light when it finally reaches Earth, Ellison can determine if there's a galaxy in between, how far away it is and its chemical composition.

The quasar light will also travel through what's known as the intergalactic medium—vast filaments and knots of gas that connect galaxies together. This is also of interest to Ellison. "Space is a very busy place," she grins.

Ellison joined UVic in 2003 after three years at an observatory in Chile. She's also worked with telescopes in Australia, Spain and Hawaii and recently completed a project using the Hubble Space Telescope. Her ongoing work, funded by the Natural Sciences and Engineering Research Council and the Canada Foundation for Innovation, enhances UVic's growing reputation as a world-class centre for galaxy research.

"Our theory group does simulations on how galaxy structure evolves over time, and my observations can test those theories," she says. "It's a perfect fit."

Gregg Eligh photo

Ellison with a celestial globe

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For the last six years, Sara Ellison has led an international project to verify the accuracy of using quasars to study galaxies.

"The concern was that if we have a galaxy that's far along in its evolution and has produced a lot of dust which absorbs light, we might not be seeing a quasar behind it," she explains. "So our optical surveys might be biased against more evolved galaxies."

The Complete Optical and Radio Absorption Line System Survey (CORALS) used radio telescopes—which measure electromagnetic waves that go straight through dust—to select distant quasars. The results were then compared to data from optical telescopes.

"What we've found out so far is that there's not a big difference. That's good news because it means we can still rely on data from optical surveys, which are a lot easier to do."

Follow-up studies are planned over the next new few years. One of these, using the Very Large Telescope (VLT) in Chile, will determine whether the galaxies identified by CORALS are more chemically evolved due to higher rates of star formation. Another study, using the Hubble Space Telescope and radio telescopes in West Virginia and India, will measure how much gas is in these galaxies, and their temperatures.

"These observations will provide one more piece of the puzzle toward figuring out the nature of distant galaxies," she says.