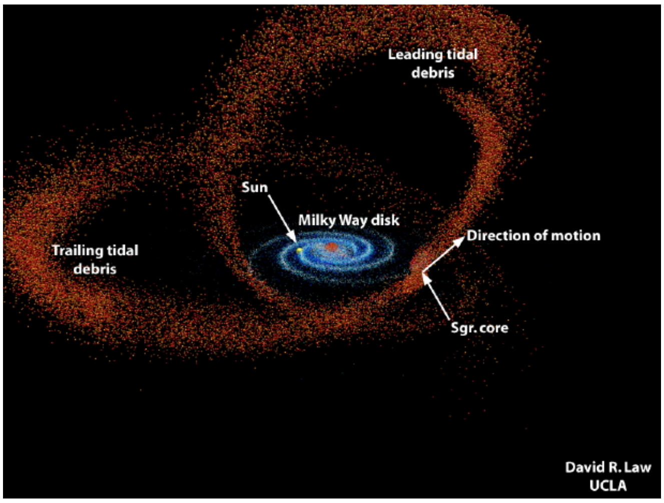
Astronomers measure detailed chemical abundances of 158 stars in a nearby dwarf galaxy

17 July 2017, by Tomasz Nowakowski



This image shows the model of the tidally shredded Sagittarius dwarf galaxy wrapping around a 3-D representation of the Milky Way disk (flattened blue spiral). The yellow dot represents the position of the Sun. Credit: David R. Law/UCLA.

(Phys.org)—An international team of astronomers has performed detailed measurements of the chemical composition of 158 red giant stars in the nearby Sagittarius dwarf galaxy. The study, presented in a paper published July 11 on arXiv.org, is so far the largest and most chemically extensive high-resolution survey of this galaxy.

Discovered in 1994, Sagittarius is a nearby, massive, elliptical loop-shaped satellite galaxy of the Milky Way. The dwarf is currently merging with our galaxy, resulting in massive tidal tails that can be found in the Galactic halo. Therefore, detailed studies of Sagittarius could clarify the formation of Milky Way's halo. Due to its proximity (about 88,000 light years away), the stars in the core of this dwarf galaxy are excellent targets for high-resolution spectroscopy observations using ground-based telescopes.

So a team of researchers led by Sten Hasselquist of the New Mexico State University recently conducted detailed spectroscopic observations of Sagittarius as part of the Apache Point Observatory Galactic Evolution Experiment, or APOGEE. The main goal of this survey is to study over 100,000 red giant stars across the full range of the galactic bulge, bar, disk, and halo. APOGEE makes use of a high-resolution near-infrared spectrograph connected to the Sloan Foundation 2.5m Telescope at Apache Point Observatory in New Mexico in order to penetrate the dust that obscures significant fractions of the disk and bulge of our galaxy.

Hasselquist and colleagues has used APOGEE's spectrograph to estimate chemical composition of a large group of stars in Sagittarius. They managed to measure chemical abundances for the 16 elements, namely carbon (C), nitrogen (N), oxygen (O), sodium (Na), magnesium (Mg), aluminium (Al), silicon (Si), phosphorus (P), potassium (K), calcium (Ca), vanadium (V), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co) and nickel (Ni).

"The Apache Point Observatory Galactic Evolution Experiment provides the opportunity to measure elemental abundances for C, N, O, Na, Mg, Al, Si, P, K, Ca, V, Cr, Mn, Fe, Co, and Ni in vast numbers of stars. We analyze the chemical abundance patterns of these elements for 158 red giant stars belonging to the Sagittarius dwarf galaxy (Sgr)," the researchers wrote in the paper.

These measurements revealed that Sagittarius is deficient, at various levels, in all the studied chemical-abundance ratios relative to iron. This indicates that the most recent generation stars in the dwarf galaxy with metallicity higher than -0.8

formed from gas that was much less polluted with Type II supernovae than the gas that formed stars in the Milky Way's disk and bulge.

"We find that the Sgr stars with [Fe/H] > -0.8 are deficient in all elemental abundance ratios (expressed as [X/Fe]) relative to the Milky Way, suggesting that Sgr stars observed today were formed from gas that was less enriched by Type II SNe than stars formed in the Milky Way," the paper reads.

The team also also found that asymptotic giant branch stars are much larger contributors to the chemical enrichment of Sagittarius when compared to our Milky Way galaxy.

"We find clear signs of AGB enrichment beginning at [Fe/H] ? -0.6 in [(C+N)/Fe], [Na/Fe], and [Al/Fe], and that the abundance patterns of these elements approach the MW trend in the most metal-rich Sgr stars," the authors noted.

More information: APOGEE Chemical Abundances of the Sagittarius Dwarf Galaxy, arXiv:1707.03456 [astro-ph.GA] arxiv.org/abs/1707.03456

Abstract
The Apache Point Observatory Galactic Evolution Experiment (APOGEE) provides the opportunity to measure elemental abundances for C, N, O, Na, Mg, Al, Si, P, K, Ca, V, Cr, Mn, Fe, Co, and Ni in vast numbers of stars. We analyze the chemical abundance patterns of these elements for 158 red giant stars belonging to the Sagittarius dwarf galaxy (Sgr). This is the largest sample of Sgr stars with detailed chemical abundances and the first time C, N, P, K, V, Cr, Co, and Ni have been studied at high-resolution in this galaxy. We find that the Sgr stars with [Fe/H] ? -0.8 are deficient in all elemental abundance ratios (expressed as [X/Fe]) relative to the Milky Way, suggesting that Sgr stars observed today were formed from gas that was less enriched by Type II SNe than stars formed in the Milky Way. By examining the relative deficiencies of the hydrostatic (O, Na, Mg, and Al) and explosive (Si, P, K, and Mn) elements, our analysis supports the argument that previous generations of Sgr stars were formed with a top-light IMF, one lacking the most massive stars that would normally pollute the ISM with the hydrostatic elements. We use a simple chemical evolution model, flexCE to further backup our claim and conclude that recent stellar generations of Fornax and the LMC could also have formed according to a top-light IMF.

APA citation: Astronomers measure detailed chemical abundances of 158 stars in a nearby dwarf galaxy (2017, July 17) retrieved 25 November 2020 from https://phys.org/news/2017-07-astronomers-chemical-abundances-stars-nearby.html