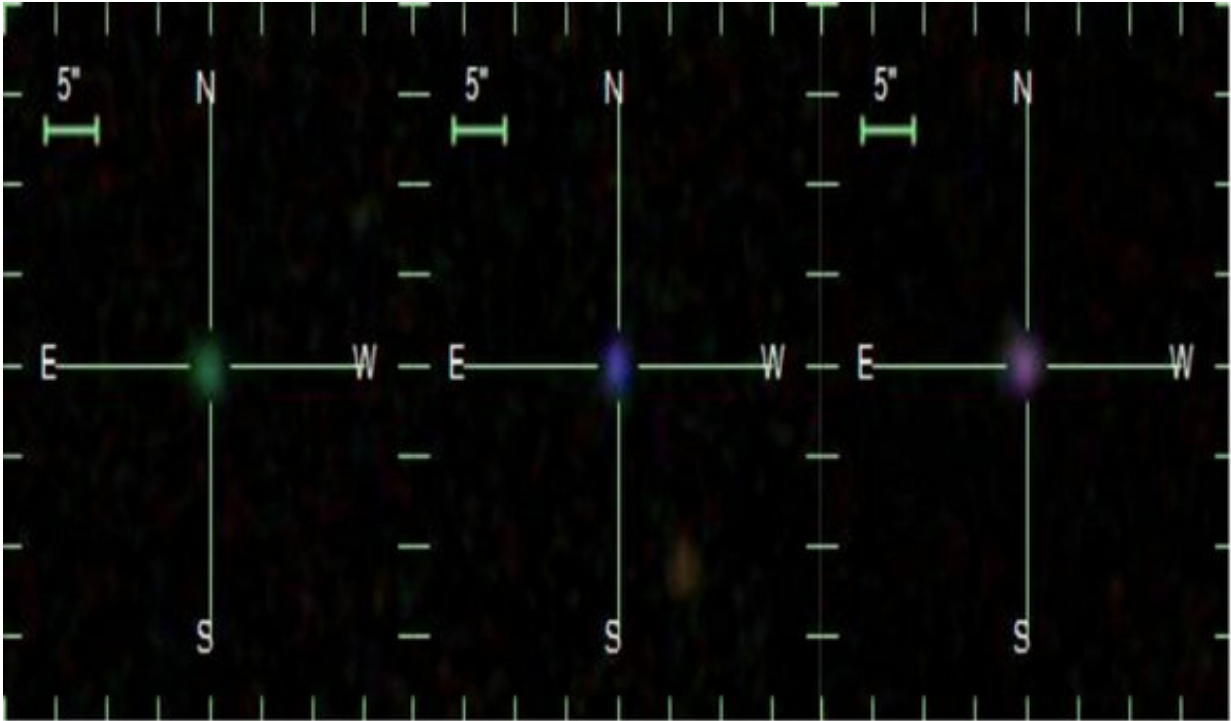


Compact galaxies discovered by LAMOST

March 30 2022, by Li Yuan



From left to right are images of a Green Pea galaxy, a Blueberry galaxy, and a Purple Grape galaxy. Credit: SDSS

A research team of Chinese astronomers has recently discovered 1,547 compact galaxies in the LAMOST DR9, of which 1,417 are newly discovered and include a large sample of Green Pea, Blueberry and Purple Grape galaxies. This is the largest sample of new compact galaxies discovered at one time to date.

The team was led by Ph.D. student Liu Siqi and Prof. Luo Ali from the National Astronomical Observatories of the Chinese Academy of Sciences (NAOC), together with Prof. Wang Junxian from the University of Science and Technology of China (USTC) and Prof. Shen Shiyin from the Shanghai Astronomical Observatory of CAS (SHAO).

The researchers conducted a systematic study of the [star formation](#) rate, metallicity and environment of these galaxies, providing a new perspective for understanding the formation and evolution of galaxies in the early universe.

Results were published in *The Astrophysical Journal*.

The Green Pea galaxies were originally identified and given their unusual name by participants in Galaxy Zoo, a project run by citizen scientists. When a group of amateurs classified the galaxies observed by the Sloan Digital Sky Survey (SDSS) according to their color and morphology, they found 251 extremely special galaxies that could not be easily classified according to known galaxy types. These galaxies, which looked round and dense like beans and appeared green on [digital images](#), were subsequently named "Green Pea galaxies."

The Green Pea galaxies are about 1.5 billion to 5 billion light-years away and are less than 1/10 the size and 1/100 the mass of the Milky Way. The strong [OIII] emission lines of the Green Pea galaxies give them a bright green color, which also means that new stars are intensively forming within.

The Green Pea galaxies have a high star formation rate in the local universe—a rate about 10 times that of the Milky Way—thus causing their masses to double in a few hundred million years. They are also known for their low metallicity and were likely common in the early universe. Therefore, the study of Green Pea galaxies opens a new

window for understanding the formation and evolution of galaxies and star formation in the early universe.

Due to the different positions of the emission lines in the photometric bands, typical compact galaxies also include "Blueberry galaxies" and "Purple Grape galaxies" that appear blue and purple, respectively, in pseudo-color images.

The Blueberry galaxies are closest to us and are more compact than Green Pea galaxies, with less than 1/3000 the size of the Milky Way. Purple Grape galaxies, on the other hand, are found between the Blueberry and Green Pea galaxies or even beyond the Green Pea galaxies. The Purple Grape galaxies have a radius similar to the Green Pea galaxies and a mass less than 1/500 of the Milky Way.

All these galaxies are small and faint, making observation very difficult and constrained. Before this work, the largest sample of compact galaxies with spectral information comprised only about 800 members.

Based on LAMOST data, this study discovered 1,417 new compact galaxies, almost twice as many as previously known. Among them are 739 Green Pea galaxies, 270 Blueberry galaxies and 388 Purple Grape galaxies—like an "extragalactic fruit and vegetable garden." These newly discovered compact galaxies range in mass from about 310 thousand to 10 billion [solar masses](#), with the most distant galaxies about 9 billion light-years away.

By studying the spectral line strength of these galaxies, the researchers found that their star formation rates are generally larger than the main-sequence star formation rates of other galaxies at the same redshift. The scientists also measured the galaxies' metallicity and confirmed that these values—which are lower than those derived in previous studies—are accurate.

Moreover, the researchers also found that these galaxies are more isolated from each other compared with other galaxies at the same redshift.

As LAMOST's extragalactic survey continues, more compact galaxies like the Green Pea, Blueberry and Purple Grape galaxies will be discovered, thus making it easier to understand the formation and evolution of [galaxies](#) in the early universe.

More information: Siqi Liu et al, Strong [O iii] λ 5007 Emission-line Compact Galaxies in LAMOST DR9: Blueberries, Green Peas, and Purple Grapes, *The Astrophysical Journal* (2022). [DOI: 10.3847/1538-4357/ac4bd9](#)

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