TODAY'S PROGRAM

Program: Discovering New Galaxies in the Nearby Universe
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Attendance: 93
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This week's Zoom recording can be viewed at: www.scientechclub.org/zoom/477.mp4

Dr. Rhode is an Associate Professor of Astronomy at IU Bloomington. She has a PhD in astronomy from Yale University.

Less than 100 years ago astronomers believed that the Milky Way was all there was to the universe. In 1924 Edwin Hubble showed that other galaxies existed and measured the distance to the Andromeda Galaxy using the 100 inch Mt. Wilson telescope in California. Though the largest optical telescope in the world at the time, the Mt. Wilson telescope is not used much anymore due to light pollution from Los Angeles
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At the time, astronomers knew about spiral "nebulas" but they were not sure what they were. Hubble was able to see that they were composed of individual stars and gas. He measured the distance to Andromeda as 900,000 light years, but we now know that it is twice that distance. This made Hubble the "father" of extra-galactic astronomy.

In 2004 the Hubble space telescope was focused on a "blank" area of the sky and found more than 10,000 objects, most of which were galaxies. The area was only 1/50th the size of a full moon. Each galaxy has billions of stars, hundreds of billions of stars for the larger ones, and presumably, planets as well.

Galaxies are collections of dust, gas, stars, and dark matter, which all orbit the same center of gravity. The gas is mostly hydrogen. We can only detect dark matter by the gravity it exerts. Astronomers are studying how galaxies form and how they evolve. The types of galaxies, classified by Hubble, are elliptical, spiral, barred spiral, and irregular. The Milky Way is a spiral galaxy. It has a gas disk, spiral

arms, and a nuclear bulge with about 200 billion stars in it. A barred spiral galaxy has a nucleus that is shaped like a bar, with the arms coming off the ends of the bar. Elliptical galaxies can be near circular to very elliptical, and are much more massive than spiral galaxies. Irregular galaxies are, as the name implies, irregular in their form.

Dr. Rhode is studying another type of galaxy called "dwarf" galaxies. They are much more common than the larger galaxies, and much smaller, thus harder to find. Most of them have only 10's of thousands of stars, compared to billions of stars in the larger galaxies. In the local area (3 million light year radius) of the Milky Way, there are 3

spiral galaxies and about 70 dwarf galaxies found so far. Some of them have just old stars and no more gas left for new star development.

Dwarf galaxies are good to study because they provide simple laboratories for studying how stars form, what happens to the gases in galaxies, what happens when stars go supernova, etc. Dwarf galaxies tend to be found together in pairs or groups. Sometimes they form long chains. Dwarf galaxies can be used to prove or disprove the predictions made by theories.

Astronomers are doing surveys to map the dwarf galaxies in the universe. They use images to find areas that have over-densities of stars. Dr. Rhode's group is using radio telescopes to detect gases, and then look for stars in the same location with optical telescopes. They were using data from the Arecibo radio telescope in Puerto Rico. Fortunately the survey was completed before the Arecibo telescope was recently destroyed by an earthquake. Then they use the WIYN telescope on Kitt Peak in Arizona to look for any corresponding stars. Indiana University is a 25% owner of the WIYN telescope. Leo P was the first dwarf galaxy that they found. They have since found some more candidates that have not yet been confirmed as dwarf galaxies. Some are as small as 400 solar masses and some are as large as 400,000 solar masses. Spectroscopic data is used to figure out if the gas and stars together form a dwarf galaxy.

The WIYN observatory has just added something called the NEID Spectrometer, funded by NASA, which is able to detect exo-planets in other galaxies. It does so by detecting a wobble in the star which shows that a planet is orbiting the star.

In conclusion, there has been a lot of progress in the understanding of galaxies in the last 100 years and there is much more to learn. By discovering earth-like exo-planets, we hope to someday find evidence of life out there.

Katherine L. Rhode, PhD