

Episode 23: NGC 300

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- Travis: Welcome to show number twenty-three of Slacker Astronomy; a podcast about astronomy and just about anything else that floats over our heads.
- Pamela: Every week or so we will bring you a summary of a recent news event from the world of astronomy. And during slow news weeks, we'll read aloud from textbooks that haven't been approved by the Kansas School Board.
- Travis: But this week's show requires no warning labels, although it will require you update your extragalactic map.
- Pamela: Astronomers studying the galaxy NGC 300 measured a new and improved distance from here to there, and have remapped some of its outer suburbs, detecting previously unseen levels of urban sprawl.
- Travis: The not particularly creatively named NGC 300 is a spiral galaxy roughly half the size of our own Milky Way galaxy. NGC 300 is located in the nearby Sculptor group of galaxies.
- Pamela: Galaxies, like people, prefer not to be alone. The more outgoing . . .
- Travis: And somewhat suicidal . . .
- Pamela: . . . galaxies tend to hangout in giant galaxy clusters with a few hundred of their closest friends. In these dense clubs, galaxies often sweep past each other in a huff, gravitationally messing up one another's structure and sometimes even tearing one another apart.
- Travis: If you want to study galaxy structure, this is not the place to go. Just like you won't find many examples of the typical human form at a fashion model convention, you aren't going to find many typical galaxies in a galaxy cluster.
- Pamela: More normal galaxies tend to hang out in small groups with just 3 to 12 of their equals and countless little hangers on.
- Travis: Our own Milky Way Galaxy is part of the logically named Local Group. We, along with the Andromeda and Triangulum galaxies, dominate our little gathering, and each of us has our own small posse of dwarf galaxies that orbit us and occasionally feed us their stars and gas.
- Pamela: The Sculptor galaxy group is the nearest galaxy group to our own. The galaxies in this group have thus far kept to themselves, and the member galaxy NGC 300 shows no signs of being gravitationally roughed up by another large galaxy.
- Travis: NGC 300's unmussed structure makes it perfect for studying the natural form of free-range galaxies.

Pamela: Using the Gemini South 8-meter telescope in Chile, astronomers led by Joss Bland-Hawthorn of the Anglo-Australian Observatory studied the outer edges of NGC 300 looking for stars.

Travis: Anyone driving through the middle regions ...

Pamela: ... the red states ...

Travis: ... of the United States may have noticed that some cities have a definite edge.

Pamela: "You are now entering Smallville. The entire population of 5000 lives between here and leaving Smallville sign."

Travis: And other cities seem to never end, with their population of farmers, naturists, and the occasional isolationist sprawling for tens of miles beyond the city limit signs.

Pamela: Astronomers had previously thought that galaxies tended to be more of the definite edge variety, like our fictional Smallville. Standard models of galaxy structure showed that the disks of spiral galaxies fall off exponentially and at a certain point break off.

Travis: Astronomers cleverly call this point the break radius.

Pamela: Basically, if you make a plot of the brightness of a galaxy versus distance from the center of a galaxy, you'll find that the brightness drops exponentially out to a certain radius, and then smoothly breaks. This break radius defines a normal galaxy's city limits.

Travis: But NGC 300 isn't normal. Instead of having a break radius, its stellar population keeps going and going, extending roughly twice as far as astronomers had previously thought.

Pamela: Gemini was able to resolve faint stars 47,000 light years from the galaxy core, giving the galaxy a diameter of at least 94,000 light years.

Travis: NGC 300 isn't the only galaxy undergoing growth spurts. Astronomers observing the nearby Andromeda Galaxy announced that it is also twice as large as we once thought. Urban sprawl seems to be the way of the universe. Next thing we know, there'll be Hummers fighting for spaces in the outer solar system!

Pamela: While the main bulk of the Milky Way is roughly twice the size of the main bulk of NGC 300, Astronomers had previously thought our own Milky Way was only about 100,000 light years in diameter. Now that we know NGC 300 is so large, some astronomers are thinking that our galaxy could be more like 200,000 light years across.

Travis: According to the Gemini Press Release, which we have linked in our show notes, the stars in the outer regions of NGC 300 are the dying remnants of an ancient stellar population.

Pamela: While the downtown districts of cities like Detroit are dying out while the suburbs thrive, in galaxies the central regions are full of activity while suburbs

are emptying out.

Travis: And no suburban renewal program will insert life into these aged outer areas.

Pamela: To see these faint stars extending away from NGC 300 astronomers had to obtain images that detect objects 10 times fainter than any prior image, and that were obtained under suburb conditions.

Travis: Had we been looking at NGC 300 a few billion years ago, when those now ancient stars were still young, mapping this galaxy would have been significantly easier. When the galaxy was young, and the suburbs were still actively forming stars, the outer parts of the galaxy were just as bright as the modern core.

Pamela: Back then, your casual backyard telescope and scientific digital camera would have been able to map all of NGC 300, while today's discovery required a telescope with a mirror 8-meters, or 26 and a quarter feet in diameter.

Travis: And to figure out that NGC 300 is 6.13 million light-years away actually required an 8.2-meter or 27-foot diameter mirror.

Pamela: In astromomy size **is** everything.

Travis: It is easy to measure the angular size of an object in the sky. We won't go into details, but while the process is a wee bit harder then holding a protractor at arms length, it is still something we could teach you in 5 minutes with the correct props.

Pamela: All you need to know is that something's angular size is the number of degrees it would take up if you lived at the center of a clock. An object that appears to stretch from noon to 1pm has an angular size of 15 degrees. The moon is about half a degree across.

Travis: If you know an object's angular size and distance, you can figure out how big it actually is.

Pamela: For instance, if a truck across a normal street from you takes up 30 degrees of your field of view you know it is HUGE,

Travis: And if it takes up 3 degrees of your field of view, you know circus clowns are somewhere nearby.

Pamela: So the folks using Gemini very very carefully measured the angular size of NGC 300.

Travis: And some other folks, using the Very Large Telescope's Antu telescope very carefully measured the distance to NGC 300.

Pamela: Measuring distances to galaxies is a tricky business. Using geometry we can measure the distances to nearby stars using a trick called stellar parallax.

Travis: We'll have a link to an explanation with pictures on our website.

Pamela: Think of it this way: If you hold your finger up and block out some distant object with your finger while looking out just one eye, and then switch to

looking out just the other eye, you'll see your finger jump to blocking out some different distant object.

Travis: Your left eye is like the Earth in June, and your right eye represents the Earth in December. The background objects are distant quasars, and your finger is a nearby star.

Pamela: If you move your finger closer and further from your face you'll notice that it jumps more when it is close, and less when it is far.

Travis: With a bit of math, you can actually calculate how far your finger is from your eye by figuring out how much it appears to move against the background. Personally though, I prefer to use a ruler for that short a distance.

Pamela: But astronomers, who can't use rulers, actually measure how stellar positions appear to move against background quasars to get the distances to some stars.

Travis: But this only works for nearby stars. Far away stars just don't have a measurable change in position.

Pamela: So astronomers need another tool.

Travis: And this tool – pulsating variable stars – it part of what pays Aaron and my salary during our day job!

Pamela: Some stars, called pulsating variables, change in brightness in a methodical way. There are a lot of different types of pulsating variables, but one type in particular is used to measure distances to galaxies.

Travis: Back in 1912 a woman by the name of Henrietta Leavitt noticed that Cepheid variables have periods that are directly related to their luminosities. She figured out that Cepheids that get dimmer and then brighter quickly are fainter than stars that beat more slowly.

Pamela: And Cepheids are big stars – big and luminous and easy to see when they are in distant galaxies like NGC 300.

Travis: And in our own Milky Way some of them are close enough that we can get a pretty good parallax distance to them.

Pamela: So, locally we measure the distance to them with parallax, and we measure how bright they appear, and we use this distance and brightness to calculate how much light they actually give off.

Travis: It's that math stuff again. Think of it this way: If you see a set of headlights that appear really faint, you know the car is far away. If you see blindingly bright headlights, be certain you are about to die. What allows you to mentally calculate the distance to a car also allows us to calculate the actual brightness of stars.

Pamela: So, we know how much light Cepheids actually give off thanks to parallax, and by measuring how bright Cepheids appear in other galaxies, we can measure the distance to other galaxies.

Travis: And using the Antu telescope astronomers were able to make out individual

Cepheids in NGC300 and determine that it is 6.13 million light years away. This is the most accurate distance determination ever made for something outside of our own Local Group.

Pamela: And the cherry on top of the story is the beauty of NGC 300. All these scientists were taking pictures of one of the prettiest little galaxies in our skies. It's always nice when you can spend your time staring at something easy on the eyes.

Travis: So that's why you keep me around this podcast!

Pamela: Um, well, err ... Thanks for listening everyone, this has been Slacker Astronomy...

Travis: WAIT – didn't you have some announcements?

Pamela: Oh yeah – We're doing a survey! I'm going to a meeting on education and public outreach in Tucson in September, and I'm going to be talking about the Who, What, When, Where and How's of Podcasting. While I'm pretty set on the How's and Why's, I need your help finding out about the Who's – Specifically about you, our listeners. If you go to the www.slackerastronom.org/survey.php we have a set of 20 simple questions for you to answer.

Travis: And one of those questions is “What's your email address?”

Pamela: And we are going to use the answer to that question to notify one lucky person that they have won a \$50 gift certificate to iTunes.

Travis: Not above bribery, are you?

Pamela: For the good of research, I'll do just about anything! And folks, this survey isn't just for listeners of this show, it is for listeners of all astronomy and science podcasts. So if you have any friends who listen to Skepticity or Universe Today, tell them about this survey too. The more podcast listeners who fill out this survey, the better I will be able to explain the podcast listening audience to other astronomers.

Travis: And if you have any feed back for us about this survey or about anything else, please drop us an email at info@slackerastronomy.org. As always, we are eager to hear your comments, criticism and occasional praise.

Pamela: So thanks again for listening. On behalf of Travis and Aaron, this is Pamela Gay.

Travis: Clear Skies and Clear Bandwidth. This has been Slacker Astronomy, a volunteer collaboration for you, for fun, for the voices in our heads.