

Episode 28: **Busy Black Holes**

CastDate: 050926

Written by: *Pamela Gay*

Disembodied Voices: *Travis Searle & Pamela Gay*

Engineering & Production: *Travis Searle*

- Travis: Welcome to show number twenty-eight 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 compose music to accompany the dance of the aurora borealis; music that doesn't sound like Enya!
- Travis: But this week, there are no forecast aurora and we have more news than you can shake a solar flare at.
- Pamela: Black holes have been busy providing astronomers lots of material for press releases. So busy that I don't think we can make it through everything in one show, but we'll try.
- Travis: Most locally, astronomers lead by Ralf Bender of the Max Planck Institute for Extraterrestrial Physics and John Kormendy of the University of Texas recently identified Andromeda's ring around the supermassive black hole as a bunch of blue stars.
- Pamela: Back in 1995 the University of Washington's Ivan King noticed that the supermassive black hole in the center of the Andromeda galaxy has a blue light coming from near it.
- Travis: Originally it was thought that this light might be a single blue star or perhaps some weird phenomena we don't yet know about.
- Pamela: But their original images weren't great, and when you form your theories on poor images, you sometimes also get poor explanations.
- Travis: So in 1998, Tod Lauer of the National Optical Astronomy Observatory and U of California at Santa Cruz's Sandy Faber took a new set of observations with the Hubble Space Telescope. They discovered they blue light was a cluster of blue stars.
- Pamela: And in the Sept 20, 2005 issue of the Astrophysical Journal new observations from the Hubble's Space Telescope Imaging Spectrograph show that cluster consists of 400 stars packed into a disk that is only 1 light-year across.
- Travis: Mind you, Earth's nearest neighbor, Proxima Centauri, is located 4.2 light years away. This means there are 400 blue stars...
- Pamela: ...and blue stars are larger and brighter than the Sun...
- Travis: ... crammed into a space $\frac{1}{4}$ the distance from here to Proxima Centauri.
- Pamela: These stars formed during a burst of activity 200 million years ago. This disk

of stars is embedded inside a ring of older, cooler, redder stars which was already known.

Travis: The stars in this disk are moving remarkably fast. With speeds of 3.6 million km/hr or 1,000 km/sec they are traveling 0.3% of the speed of light. At this speed, these stars could circle the Earth in 40 seconds.

Pamela: This same Earth circling trip takes the International Space Station 90 minutes.

Travis: The fastest of these stars orbit Andromeda's core in just 100 years.

Pamela: The orbital speed of these stars and their close proximity to the center of the galaxy is fairly clear evidence that the theorized supermassive black hole in the center of Andromeda is a real supermassive black hole.

Travis: While astronomers have been saying there are supermassive black holes in the centers of galaxies for a while, definitive proof has only existed for our galaxy and one other. Now we can say that solid proof exists for three galaxies.

Pamela: And if the galaxy we live in and the two other galaxies we are best able to observe the cores of all seem to have supermassive black holes, it should follow that most other galaxies also have supermassive black holes.

Travis: This is part of the idea that we are not at a special time or place in the universe. Mankind just ain't special enough to be located in a unique position.

Pamela: So what we see all around us should resemble what astronomers on the otherside of the universe also see all around them.

Travis: Implying that its supermassive black holes here, there, and everywhere.

Pamela: And it's thanks to these 400 or so centrally located blue stars that we learn so much.

Travis: Thank you Blue Stars.

Pamela: Located so close to their supermassive black hole, the stars in Andromeda should be experiencing huge tidal forces. Similar tidal forces from the Moon, cause the Earth's tides, and result from the total gravitational pull on two different sides of a planet or star being sufficiently different that the object becomes elongated.

Travis: Here on the Earth the oceans nearest the moon are pulled toward the moon creating one high tide, and the gravitational pull from the moon is least on side of the Earth opposite the moon, causing the water to be pulled toward the Earth less, creating the second high tide on the side opposite the moon.

Pamela: If the moon were suddenly replaced with a white dwarf, instead of having ocean tides, the forces would simple tear the Earth in half.

Travis: Which is definitely not a good thing.

Pamela: And the supermassive black hole in the center of Andromeda is not good for star formation. Its tidal forces should tear gas and dust apart, preventing material from collapsing into stars.

Travis: But somehow these stars formed. And these stars aren't all that unusual. Our own Milky Way galaxy has young stars near its supermassive black hole.

Pamela: So now we know there is some unknown mechanism forming stars in the centers of galaxies.

Travis: This is one of those stories that basically proves what we've been saying for years – that galaxies have central black holes – and does it with a group of stars that were formed in a way we totally don't understand.

Pamela: I foresee more Hubble Images in the future.

Travis: This particular set of images couldn't have been done from anywhere else. Only the Hubble Space Telescope has the ability to take images that are this sensitive to blue light and have this level of detail.

Pamela: And the next generation space telescope, called the James Webb Space Telescope, won't be able to repeat what the Hubble is doing now.

Travis: So in one way, we – those of us recording and those of you out there listening – do live in a special time. We live in the age of Hubble and of truly amazing observing in colors visible to the eye and just out of range of the eye in the ultra-violet and infrared.

Pamela: This week's second black hole story is also brought to you by the Hubble Space Telescope.

Travis: An international team of astronomers combining data from the Hubble Space Telescope and the European Space Agency's Very Large Telescope at Cerro Paranal in Chile recently studied 20 of the nearest quasars in new detail.

Pamela: Quasars are amazingly like points of light that are associated with distant galaxies. It is believed that the light comes from actively feeding supermassive black holes in otherwise normal galaxies. In general, galaxies seemed to be more actively eating in the past, and it is even possible that the Milky Way galaxy may once have been a quasar.

Travis: Astronomers are constantly trying to understand the galaxies surrounding quasars so they can better understand what makes quasars what they are.

Pamela: The men and women behind the data found 19 fairly normal quasars embedded in a host galaxies.

Travis: I thought they observed 20 systems.

Pamela: That they did.

Travis: And one embedded in a not so normal host galaxy?

Pamela: Nope.

Travis: No? so what's up with number 20?

Pamela: It wasn't embedded in a galaxy at all.

Travis: Oh... Weird.

Pamela: Yeah – just not normal. So, what they actually observed is somewhat complex. There is a quasar...

Travis: Obviously...

Pamela: And beside the quasar is a 2,500 light-year across blob of gas.

Travis: For comparison, the typical galaxy is 12,000 to 100,000 light years wide.

Pamela: In addition to the blob of gas, there is nearby, highly disturbed galaxy that is building stars at a frantic rate.

Travis: But there is no second galaxy to be seen. As near as astronomers can tell, whatever disturbed the galaxy and ignited the quasar occurred 100 million years ago.

Pamela: And what it is that happened is a bit of a mystery.

Travis: Let's face it, while free roaming supermassive black holes are one of those things some astronomers have been muttering about the possibility of for years, they have not been muttering about free roaming quasars. Quasars require for food and intergalactic space generally isn't so good at providing.

Pamela: So what happened? Wish I could tell you, but I can't.

Travis: Wow – an honest admission of ignorance from a PhD.

Pamela: It happens. Enjoy it while you can. The astronomers studying this naked quasar have made a few guesses.

Travis: Oooo, guesses.

Pamela: According to the European Space Agency Press Release, the quasar may be a rouge supermassive black hole that in its solitary wonderings through space it went straight through the disk of a spiral galaxy and pulled out a blob of gas as it went.

Travis: They also suggest the host galaxy that used to be associated with the quasar was completely disrupted by the collision, leaving just the one recognizable galaxy behind.

Pamela: And most exotic of all is the suggestion that the galaxy harboring the quasar is made almost entirely of dark matter and is thus invisible to our standard means of observing.

Travis: Today's show has thus far been a clear example of how finding one neat truth can raise 10 neater questions.

Pamela: And, it has been example of how supermassive black holes always have something new to offer.

Travis: And that pretty much ties up our show full of loose ends.

Pamela: Including a story on Black Holes forming at the beginning of the universe that we didn't get to, but will link to in our show notes.

Travis: You did warn that there was a bit too much news this week.

Pamea: So, we're done for today.

Travis: Perhaps even a bit over done.

Pamela: So, please send any feed back about this show or about anything else to info@slackerastronomy.org. As always, we are eager to hear your comments, criticism and occasional praise.

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

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