

Episode -1: **Galaxies in Gangs Wear Red**

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Written by: *Pamela Gay*

Disembodied Voices: *Travis Searle & Pamela Gay*

Engineering & Production: *Travis Searle*

- Travis: Welcome to show number negative 1 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 realm of astronomy. And during slow news weeks, we'll play clips from our favorite Evil and Mobile and Daily podcasts while giggling in the background.
- Travis: But this week we're going to talk to you about gangs. Specifically about a couple of groups some astronomers recently found decked out in red, hanging out at the beginning of the universe.
- Pamela: We're talking about gangs of galaxies, or, more scientifically, galaxy clusters.
- Travis: Galaxies, like people, don't like to be alone, and as astronomers look out across the universe, they find galaxies are almost always located in pairs, small groups, and even clusters with 100s to 1000s of members. Our own Milky Way galaxy has teamed up with the spiral galaxies Andromeda and Triangulum to form the local group. These three thugs exert their gravity to lock in countless numbers of smaller galaxies.
- Pamela: Galaxy groups and clusters are violent places. Whenever a small galaxy gets too close to a larger galaxy, it gets shredded. Our own Milky Way galaxy is currently in the process of tearing apart the Sagittarius Dwarf Galaxy and splattering its stars in streaks through space.
- Travis: And when two of the bigger bullies gravitationally butt heads, real fireworks can occur. If you look in our show notes you'll see a Hubble Space Telescope image of two clashing galaxies, named the Antennae. This system is actually visible in a typical backyard telescope, if your backyard is located some place in the middle of nowhere, like West Texas, where the stars at night are big and bright.*
- <clip from "Deep in the Heart of Texas">
- Pamela: Deep in the Heart of Texas, at the Texas Star Party, and in fact at many other observatories and star parties around the world, astronomers peering at this tangled mess of stars and gas have realized, they are looking at the death of two spiral galaxies. As these systems smash together, the gas and dust in each system collapses, producing what may be a huge, final generation of stars. As the systems merge together, these two, once spiral galaxies will form a single, elliptical galaxy.
- Travis: Some day, far in the future, our own galaxy will test fate, and smash itself into the Andromeda Galaxy.

Pamela: We don't have to worry too much though. Our Sun will swell up and consume the Earth well before our galaxy is destroyed.

Travis: This universe just isn't that safe a place, is it?

Pamela: Nope, there's a reason no one's willing to offer us planetary protection insurance.

Travis: You can thank the Vogons for that. Gangs of galaxies, planet-consuming stars, was it always this bad?

Pamela: Oh, things have actually calmed down a lot. It used to be so hot around here that even the atoms were melted. At least it's cooled off a bit.

Travis: hold on - the atoms were melted?

Pamela: Melted may not be exactly the right word. When the universe first formed during the Big Bang, everything was so hot and so dense that matter couldn't exist. Everything was pure energy. I'm going to put together a session on how scientists know about the Big Bang and post it sometime soon.

As the universe expanded, things began to cool off. Atoms began to form, and over a few million years, the atoms began to gather together and form stars, and those stars gathered together to form galaxies.

Travis: Last fall I read a news article that said the first burst of galaxy formation probably began just 500 million years after the big bang. That means that the universe went from nothing but energy to having full-blown galaxies in about the same amount of time it took life on earth to evolve from multi-celled slime to humans.

Pamela: There's a difference between multi-celled slime and humans?

Travis: Only human slime makes podcasts.

Pamela: True. So after the universe had evolved for a few hundred million years, there were some lonely galaxies floating in space looking for companionship.

Travis: According to James Rhoads and Sangeeta Malholtra at the Space Telescope Science Institute, dwarf galaxies began to trace out spongy like structures, called sheets and voids, as early as 1 billion years after the universe formed. The structures his team observed didn't look anything like the modern galaxy clusters we see near us.

Pamela: But all because they didn't see clusters like we're used to seeing, doesn't mean the giant, violent clusters we're used to didn't exist in the early universe.

Travis: You make it sounds like all galaxy clusters are violent.

Pamela: They are. It's just their nature. In clusters, galaxies are forced to interact. When one galaxy sweeps past another, as they both follow their own orbital paths through the cluster, the gravity of each galaxy affects the other. These gravitational bumps and jostles knock the gas out of some galaxies, and

trigger pre-mature star formation in others. When all the gas in a galaxy is either stripped out or used to make stars, the galaxy effectively dies. For galaxies, star formation is life.

Travis: Without star formation, it's just a matter of millions of billions of years before everything runs out of nuclear fuel and all the stars stop burning. Really big stars are blue or white, and they blaze through their nuclear fuel quickly, and when they're out of nuclear fuel, they can't buy it from the Russians, so they're forced to either blowup as a supernova, or collapse into a white dwarf. What they do depends on how much mass they manage to get rid of before they run out of fuel.

Pamela: Smaller stars are red, and they can take forever and ever to use up all their fuel. Medium sized, dying stars also turn red. The light from these small, long-lived stars and the dying red giant stars combine to make old galaxies red. Young galaxies are blue.

Travis: So just as you can tell a person is old from their gray hair, you can tell a galaxy is old by its red color.

Pamela: And no amount of L'oreal can make these red galaxies blue. And just as some of us humans go gray young from stress, the galaxies in clusters go red at a young age from being harassed by other galaxies.

Travis: And just when did all this galaxy harassment start?

Pamela: Christopher Mullis and his collaborators found a giant cluster with hundreds, or perhaps even 1000s of galaxies that was fully formed, complete with knocked around, beat up red galaxies, just 5 billion years after the Big Bang.

Travis: This means that galaxy clusters started forming even earlier than scientists had thought just a few years ago. It also means those young galaxies I read about last year went from forming themselves, to forming full fledged, modern looking galaxy clusters, complete with a bunch of red - and perhaps dead - galaxies, in just over 5 billion years. That's the same amount of time it took our Earth to go from a blob of hot stuff to what we live on today.

Pamela: You're full of geological knowledge today!

Travis: It's just bizarre to think of the time scales involved. In four billion years, a cluster of galaxies came together, tore its member galaxies apart, and put everything back together in a new form. It's like the same contractors who made those galaxy clusters ran the Big Dig!

Pamela: Another group of astronomers, using the Japanese Subaru telescope in Hawaii recently found the youngest known cluster. They caught an image of it from when the universe was just 1 billion years old. You can find a picture of this young cluster in our show notes.

Travis: This much younger cluster is less dense, and it actually has galaxies forming stars at very high rates. While the cluster wasn't a peaceful place, there aren't dead galaxies strewn all over the place. Instead, everything is very much alive. This implies that in just 4 billion years, galaxy clusters can go from vibrant,

star forming galactic nurseries to dieing communities where the big galaxies are eating the little galaxies.

Pamela: Your not going to tell us what happened on Earth over the last 4 billion years?

Travis: Well, 4 billion years ago is when microscopic life first developed on Earth. Think of it this way: The universe formed 13.7 billion years ago. A few million years after the universe formed, stars started to form. About 500 million years after the Big Bang, the first galaxies took shape, and 1 billion years after the Big Bang those galaxies started to form clusters. 5 billion years after the Big Bang, the first clusters had matured into galaxy clusters with red galaxies. Our own Earth didn't form until between 8 and 9 billion years after Big Bang. Over all of time, galaxies have continued to form, galaxy clusters have continued to grow, every thing everywhere has constantly been evolving.

Pamela: I guess the universe just can't leave well enough alone.

Travis: Does the universe look finished to you?

Pamela: The universe? No, I guess it's not finished and could still use a few more improvements, but I'm guessing this podcast is about finished.

Travis: And so is our introductory series of podcasts. We have just one more trial show, and then we're going to officially launch with a format that we're going to try and stick to.

Pamela: That doesn't mean we're going to keep our comedic timing this bad forever. We hope to always improve. It just means that our length, how we use music, and our overall style are going to settle into our own "Slacker Astronomy" way of doing things.

Travis: We've gotten a lot of feedback from you guys, and we're really grateful for all the warm wishes, and constructive criticism you've sent.

Pamela: To all you guys asking for a 30 minute daily show – sorry, it ain't gonna happen unless we suddenly become independently wealthy. We all have day jobs and our bosses probably wouldn't like it we tried to make this a daily gig.

Travis: But we are trying to make our main weekly show longer now and then. While I don't know exactly how long this show is, because, well, we're still talking, I do know it's going to be longer than our earlier 4 minute shows.

Pamela: And we're going to be adding special shows in added numbers. Sometime this week we'll be posting the first of our "Monologues on Monolithic Ideas." The first one will be on the Big Bang, and how we know it happened.

Travis: And Friday night, rather than going out and pretending to have lives, we're all going to cram into my apartment drink too much coffee or too much beer or maybe both, and babble into our mics as a group, and talk about all the Slacker Astronomy thoughts that are going through our Slacker Astronomy minds. We'll include audio submissions, letters we've received, follow ups to the news items we've covered and more. Even Aaron is going to talk.

Pamela: And no scripts will be butchered in the production of our chat session.

Travis: And, if that's not enough for you, Pamela and Aaron are going to warm Las Cruces New Mexico, leaving me to be cold here in Boston, and from the Very Large Array they are going to record roving segments on high-energy astronomy, and cows using radio telescopes to scratch their backs.

Pamela: Really, we're gonna talk about cows and telescopes. And it will make sense.

Travis: But for now, this has been our 5th podcast, and we still want to know how to make this and our website better. Please visit our website, spam our message boards, and email us anytime at info@slackerastronomy.org.

Pamela: Also on our website, you'll find our show notes, links to press releases on all the discoveries we've talked about today, as well as images of the early universe, and Travis's favorite geologic timeline, which happens to be plotted over a football field. Check it out to learn more, and leave us a message if there's anything cool we forgot to add. (And no, we're not going to post any picture of us basking in a coronal mass ejection).

Travis: I'm Travis Searle, and on behalf Aaron and Pamela, thanks for listening and remember, you're the one who asked us to make this longer.

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

And now for some Vagon poetry...

* For those of you who missed that one, this is a lyric from an old Texas song. Go check out: <http://ingeb.org/songs/deepinth.html>
This song get's played (with mass claping) and U-TX sporting events. So sing it with me folks, "The stars at night, are big and bright (clap clap clap clap) deep in the heart of Texas"