Episode 23: **Vicious Tiny Specs**

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Pamela: Welcome to yet another episode of Slacker Astronomy; a podcast about astronomy and just about anything else that floats over our heads.

Travis: Every week or so we bring you a recent news event from the world of astronomy. And when there is nothing new to report we will count the number of licks it takes to get to the center of a tootsie roll lolly pop.

Pamela: one, two, three, ….

Travis: But this week we'll mostly be counting authors instead, but that will come later in the show.

Pamela: A few weeks ago in the magazine and journal Science, astronomers announced the discovery of the first microblazar. You may remember that a regular blazar is a quasar with its jet pointed right at us.

Travis: And a quasar is a distant galaxy with a supermassive black hole in the middle. It gobbles up stellar material at tremendous rates and creates large jets of material that move at nearly the speed of light. Sometimes these jets are serendipitously pointed at the Earth. When that happens we have a blazar.

Pamela: One reason blazars are important is that most have no emission lines in their spectra. This means any structure we see in their spectra is created by material located between the blazar and the Earth. Since blazars are some of the most distant objects known, we can obtain a sort of core sample of the universe in their light.

Travis: Blazars are also the only extrasolar astronomical object that can be detected in every wavelength of the electromagnetic spectrum. And not only that, but their energy levels vary at every wavelength too. So beginnning in the gamma ray portion of the spectrum and going all the way to the end of the radio portion, blazars are very active.

Pamela: And this activity is non-periodic. Astronomers looking at these unpredictable objects never know exactly what they are going to see.

Travis: All of this energetic, chaotic behavior led to blazars being described as "viscious little dots" in a Sky & Telescope article from the mid 1980's.

Pamela: Travis, were you even born by then?

Travis: Sure thing. I even have the parachute pants to prove it.

Pamela: We're not focusing on full-grown blazars today. Instead, we're going to talk about micro blazars.

Travis: Which we'll describe as "viscious tiny specks".

Pamela: In a regular blazar, the black hole in the middle has the mass of millions of Suns. We call these super-massive black holes. In a micro blazar, the black

hole has the mass of a few Suns. We call these stellar-mass black holes. These are suspected to be the most common type of black holes in the Universe.

Travis: Regular blazars, in the centers of giant galaxies, feed on stars like SUVs on gasoline. A microblazar, on the other hand, is a member of a binary star system residing *in* a galaxy. One star is a black hole and the other star is a regular star.

Pamela: The black hole pulls material from the regular star. The material falls in toward the black hole and forms a disc around it due to the law of conservation of angular momentum.

Travis: Think pizza ball spinning into pizza crust.

Pamela: This accretion disc glows in high energies such as X-Rays because it is highly accelerated and highly compressed.

Travis: At some point, a jet of material is forms nearly perpendicular to the disc. No one knows how it is formed, but we know they exist because we can see them. Some material escapes the accretion disc by streaming up into this jet.

Pamela: Studying the jet is interesting because it allows us to test relativity. The plasma material in the jet is moving at speeds measured in fractions of the speed of light, and at these speeds Einstein's gudunken experiments become real experiments. These speeds, pressures and temperatures can't be cooked up on Earth.

Travis: With these jets we can explore neat things like time dilation for year after year.

Pamela: Time dilation can make a jet appear to be much brighter than it is, or make it appear to move faster than the speed of light – which it can't actually do.

Travis: This is because from the perspective of the jet, time is normal, but from our perspective, everything happening in the jet is happening much faster than normal.

Pamela: According to relativity, the faster you go, the slower your clock goes. This is how a fast moving Buck Rogers managed to live through 541 years of orbiting the Earth and emerge from his spacecraft as young and hansom.

Travis: Young hansom and in a gold lamay jump suit, but that's beside the point… So if the jet pointed away from us emits 10 generic units of energy in 10 seconds, we might see it as 10 generic units of energy in 10 minutes or maybe even 10 hours, depending on how fast the jet is moving. This slower apparent release of energy makes the jet appear fainter than it really is.

Pamela: And if the jet is pointed toward us, time for the jet will move faster instead of slower, and those 10 generic units of energy might seem to be emitted every 1 second instead of every 10, making the jet look 10 times brighter than it is.

Travis: Neat stuff, if not mind-boggling. Both Pamela and Aaron had to do some serious googling to try and figure this one out.

Pamela: When the jets of stellar mass black holes are pointed at us, we have a microblazer.

Travis: Just as regular blazers allow us to study intergalactic gas and other stuff, microblazars in our Milky Way galaxy, allow us to study the interstellar medium between stars.

Pamela: As these jets crash through interstellar gas and dust they are slowed down, and the energy they release illuminates the interstellar medium. The jets look like puffy clouds extending from the end of a jet. Since these clouds often emit radio light they are ever so creatively called Radio Lobes.

Travis: Up until now there have only been microblazar candidates. These are X-Ray binaries with many of the characteristics of a blazar, but other explanations, though less likely, exist to explain their behavior. This microblazar discussed in Science stands out among other microblazer candidates because astronomers have detected a certain form of gamma radiation coming from it.

Pamela: Using the High Energy Stereoscopic System, or HESS for short, astronomers detected tetra electron volt gamma rays from the microblazar candidate LS 5039.

Travis: The lead author on the paper is F. Aharonian of the Max Planck Institute for Physics in Germany. Usually in astronomical journal publications the lead author is the team leader and/or the person who did the most important work on the paper.

Pamela: Not often, but sometimes deciding who gets to be lead author instigates political bickering. One way of solving that is to list people in alphabetical order. That is what they did in this case.

Travis: The problem is that there seems to be nearly 100 coauthors on this paper! Let me count: One, Aharonian. Two, Akhperjanian. Three... (mumbles off)

Pamela: This is a limitation of the authorship system. We don't know to whom to give credit for this discovery and if we named off all 100 people then both of our listeners who are still with us will certainly join all the others by nodding off into dreamland.

Travis: (mumbling gets louder) 102, Volk, 103, Wagner. 103! In this paper there are 103 coauthors, four umlauts and four french accents.

Pamela: Now we all know that each of the 103 didn't do 0.97% of the work. As in most things, one person or a small core group did most of the work while at least one person did almost nothing.

Travis: But we will never know who did the lion share of the work.

Pamela: Which isn't totally uncommon in science. (cough)grad students(cough)

Travis: So anyway all 103 of them found tetra electron volt gamma rays from the microblazar candidate LS 5039. These high-energy gamma rays are among the most energetic form of radiation known. They can only be created by the acceleration and destruction of particles moving at relativistic speeds.

Pamela: So by detecting them, we know the source is moving near the speed of light. This is strong evidence supporting the claim that this object is a microblazar.

Travis: To be fair, the authors of the paper are careful not to claim victory in the search for the first microblazar. They want to carefully study this object further to eliminate any explanations.

Pamela: One such possibility is the existence of a pulsar in the system. The final piece of evidence could be a detection of relativistic radio emission since that cannot be explained by any known phenomenon but a blazar.

Travis: Yet despite the cautiousness, so far the evidence looks good enough to get into the journal Science. And even more importantly, it's good enough to get into Slacker Astronomy, every astronomer's nightm- I mean, dream!

Pamela: We joked a few months ago about the word blazar being the name of a drink somewhere in the midwest. but no one was able to find the recipe. So we are now asking you to come up with your own recipe for the blazar drink. Post it on our web site and at some future house party we'll test them out and award a winner.

Travis: Thanks for listening to yet another episode of Slacker Astronomy. Send feedback and romantic sonnets about Grecian urns to info@slackerastronomy.org.

Pamela: And stop by our site if you have a few minutes and fill out a listener survey we currently have online. I'm working on a study of all you fair, astronomy podcast listening souls, and I'd love to learn all about your demographics. The survey can be found at www.slackerastronomy.org/survey.php.

Travis: On behalf of Pamela and our author Aaron, I'm Travis Searle. This has been Slacker Astronomy. A podcast for you, for fun, for the voices in our heads.