Episode 5: **Sakurai Strips for VLA**

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Travis: Welcome to Slacker Astronomer, a podcast about astronomy and anything else that floats over our heads.

Pamela: Like every Dennis Miller joke.

Travis: Each week we will bring you a recent news event from the world of astronomy. And when nothing is happening, we'll take shots until we see stars of our own and then talk about them.

Pamela: A really quick note before we get rolling into the positive, life-affirming subject of dying stars. We've been getting lots of e-mails about our opening music. We have three selections, all of which were composed and performed by our very own Travis Searle. If you want to use the music, please e-mail Travis first at info@slackerastronomy.org. Now, back to our regularly scheduled program, in progress.

<goofy muzak?>

Pamela: Most people know of supernovae, which occur when really big stars die.

Travis: You mean like when CNN starts airing old Larry King interviews? And cable and radio stations flood the airwaves with touching tributes accompanied by sad piano music?

Pamela: More like the really big explosions in space when a star suddenly becomes as bright as an entire galaxy.

Travis: Ah, a young publicist's (wet) dream...

Pamela: Most regular stars don't die in such a violent explosion though. This sort of a glamorous death is reserved for the largest stars.

Travus: Most of stars die by softly puffing out shells of gas until only the center of the star is left. We thought that this took a long time, but last week astronomers at the National Radio Astronomy Observatory announced that they have been watching one star die over the past 9 years, and it is happening far quicker than predicted.

Pamela: The star's geek name is V4334 Sagittarius. A better name for it, which the press uses, is Sakurai's Object.

Travis: It was discovered in 1996 by Yukio Sakurai of Japan. At the time it was thought to be a novae, which literally means new star.

Pamela: Previously, astronomers had never seen a star at that location in the sky. Sakurai was looking in the area, found the star, and reported it to authorities.

Travis: Authorities? The star police?

Pamela: The Central Bureau of Astronomical Telegrams. They are a group of astronomers working at the Harvard-Smithsonian Center for Astrophysics. They are charged by the International Astronomical Union to be a clearinghouse of discoveries of many types, including nova.

Travis: So they are like the “Entertainment Tonight” of astronomy, always pushing new stars.

Pamela: Okay, that's the end of the Hollywood analogies.

Travis: But they're so easy!

Pamela: Discovery of novae by amateurs is fairly common. It happens rougly five times a year. Most of the time these novae get bright for a few days or weeks and then slowly fade away, never to be seen again.

Travis: Like MacAurthur.

Pamela: Stop it!

Travis: (pleading) That wasn't about Hollywood.

Pamela: No more analogies, period.

Travis: A few days after Sakurai's announcement, astronomers at the European Southern Observatory discovered that this nova was different by looking at its spectra. The largest difference was the absence of Hydrogen in the spectra of the star going nova. This means that either Hydrogen isn't present or it was being blocked somehow.

Pamela: Most stars shine by burning hydrogen, which is the most abundant element in the Universe. Regular, middle-class stars, also know as main sequence stars, fuse Hydrogen into Helium. This creates the light we see from a star.

Travis: Because of lack of Hydrogen lines in the spectrum, we conclude that Hydrogen is *not* being burned in Sakurai's Object. But something clearly *is* being burned or else the star wouldn't be so bright. So what is it?

Pamela: Helium. As a gas it MAKES YOU TALK LIKE THIS (use high pitch FX).

Travis: And saved the career of many a clown.

Pamela: And entertained bored teenagers in small quiet towns the world over.

Travis: Helium is heavier than Hydrogen. And it takes two hydrogen to make a helium… And there are things like high temperture and high pressure and other stuff that helps too.

Pamela: As hydrogen burns into helium it creates radiation pressure that holds up the outer layers of the star.

Travis: Eventually the Hydrogen runs out and stops burning. When this happens, the outer layers of the star lose their support and they fall toward the stellar core like a bunch of pancakes.

Pamela: The radiation pressure from burning Helium in the center must hold up these layers and to do so it needs to begin burning too. So the Helium begins to fuse mainly into the next heaviest element on the periodic table, Carbon.

Travis: Notice a pattern?

Pamela: A lighter element burns into a heavier element, filling the stellar core. Then the heavier element begins to burn and makes something even heavier. The cycle just keeps going until there isn't enough pressure or a high enough temperature to burn something heavier.

Travis: For stars about the size of our Sun, this cycle stops with Carbon.

Pamela: For larger stars this goes on until Iron is formed, and we get a supernova, which we'll talk about another time.

Travis: Each time one of the heavier elements begins to burn, its radiation pressure blows off shells of the star. These puffs form the beautiful objects known as planetary nebulae - sublime clouds of mostly blue and green that can form some pretty wacky shapes.

Pamela: There is one bright example of a planetary nebula visible June through September from dark locations. The constellation Lyra marks one of the three corners of the summer triangle. The brightest star in this little constellation is Vega. If you scan around this star with a pair of binoculars, you'll see a faint little smoke ring of a smudge, called the ring nebula. This is a very faint bit of gas, and you'll need to be somewhere very dark to see it.

Travis: Planetary nebula, like the Ring, are formed once all the fusion cycles have run their course and puffed off the outer layers of the star, the only thing left is the Carbon core. Everything else has been puffed away. The isolated carbon core becomes a White Dwarf.

Pamela: White Dwarfs do not shine from burning anything. They radiate leftover heat from the earlier fusion cycles. In fact, after trillions of years they will cool down into a dark ember in space.

Travis: Because white dwarfs are so amazingly small they are relatively dim as far as stars go. There is some speculation that they are crystalline in structure.

Pamela: Crystalline carbon makes a diamond! A diamond star!

Travis: In this case a really dense diamond – A diamond ring that would normally weigh 1 caret might way hundreds of pounds if it were made up of the same stuff that makes a white dwarf!

Pamela: Great, yet another reason for brides to work out at the gym before the big day.

Travis: This is where Sakurai's Object becomes interesting. Since there was no Hydrogen in the spectra, we think that it is burning Helium. So Sakurai's object should be in those final stages of death where Helium is being fused into Carbon.

Pamela: Our best calculations predicted that each stage of burning should take a few hundred years. But instead, they seem to take just a *few* years - one hundred times faster than thought.

Travis: Astronomers have been following Sakurai's Object with the Very Large Array for the past 9 years. Remember we were at the Very Large Array for our first sound seeing tour about a month ago. It can still be downloaded via our site if you missed it.

Pamela: The star itself has become so faint that we can't see it optically. It is likely obscured by a lot of dust and material from previous puffs of the star's outer layers. But with a radio telescope we can peer through the dust and see the star itself.

Travis: The sudden brightening of the star in 1996 was the last stage of Hydrogen burning ever to take place in that star. Some Hydrogen from the outer layers was mixed with some Helium in the core through a process called convection.

Pamela: Convection is the process by which warmer material moves to the surface while cooler material moves to the bottom.

Travis: This is what happens in lava lamps. It also happens on the Sun and in some of our gas giants like Jupiter.

Pamela: Convection brought some of the Hydrogen down to the core of the star. Eventually there was enough to burn brightly for a few years. Then it was all gone. This is the last gasp of a dying star, trying to recover some of its former glory.

Travis: But it doesn't die without leaving some hope. That same convection brings some of the heavier elements in the core of the star to the surface. It then gets puffed out along with the remaining Hydrogen. These heavy elements include Carbon and Oxygen. Sound familiar?

Pamela: Carbon and Oxygen are just a couple of things needed for the formation of planets and life.

Travis: So these dying stars help seed their neighborhood with these ingredients so that later stars can form into solar systems like our own.

Pamela: In fact, we find evidence for the theory in meteorites that contain the exact isotope of carbon created by these final Helium flashes. This suggests these meteorites, and our solar system by extension, owe part of our existence to a star that underwent such a Helium Flash in our neighborhood some time ago.

Travis: So we see that dying stars don't exactly fade away smoothly. They sometimes will undergo fits trying to regain some lost glory and remain young.

Pamela: Like a 50-year old former starlet getting a face lift.

Travis: You said no analogies!

Pamela: Yeah, well you abused your privileges. Mine actually make sense.

Travis: Plastic surgery and a helium flash!!!

Pamela: Well I was trying to...

Travis: Plastic surgery and a helium flash...?

Pamela: But, it...

Travis: Pamela. Plastic surgery and...?

Pamela: Okay okay, it was silly. No more analogies.

Travis: That's it for today's show. Show notes are available on our site at slackerastronomy.org.

Pamela: And thanks for all the kind e-mails you've been sending. We have replied to over 50 e-mails in April alone. We plan to respond to some of the scientific questions in our next Chit Chat show, coming soon.

Travis: Remember, the best thing you can do to keep us going is to tell your friends and link to us on your sites and blogs.

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

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