

Episode 25: **A Star, By Any Other Name**

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<pre music>

Pamela: Hi - before we start the show, I'm taking the mic hostage to beg you to please fill out our listener survey. There are roughly 14000 of you slackers listening, and although I'm trying to bribe you with a \$50 iTunes gift certificate, only 200 of you have filled out our 20-question survey. This is a scientific study for publication in a peer reviewed online journal. If you filled out our survey last summer, we are really truly begging you to fill it out again. So PLEASE PLEASE, for the love of our careers, go to the website after this show and fill out this survey.

Travis: For the love of getting her to stop crying over her insignificant statistics, fill out the survey. We need responses by Wed Feb 8, midnight GMT, 7 Eastern.

Aaron: Okay – let's return to our regularly scheduled show...

<music>

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

Travis: Every week or so we will bring you a recent news event from the world of astronomy. And when there is nothing to report, we will unveil our new astronomical match making service.

Pamela: Wait, that would require that we actually have a few female listeners.

Travis: Hmmm, it's the Internet. Your **actual** gender doesn't matter.

Pamela: Hmmm. So perhaps I'm not actually female. Maybe I just play one on the podcast.

Travis: And maybe I'm not male, but play one as well.

Pamela: So if I'm really a man, (deep or completely new voice) perhaps this is my real voice.

Travis: And if I'm a female, (high or completely new voice) maybe I really talk like this.

Pamela: (regular voice) Or maybe this **is** my voice, as a man in touch with his feminine side.

Travis: (regular voice) Or maybe this **is** my voice, as a female who smokes too much.

Pamela: Ah, to be male or to be female, (speedy) or to be a male inside a female or to be a female inside a male.(regular)That is the question.

Travis: Classification is always tough. Despite what our brilliant leaders want us to believe - we actually live in a world of greys.

Pamela: You want to disprove the stereotype of the astronomer as dull geek? Just ask him or her their opinion on a debate about classification. Then get out of the way.

Travis: Or better yet, point them at the nearest telemarketer.

Pamela: One of the biggest classification debates involves stars; one of the most basic and seemingly simple of astronomical objects.

Travis: But astronomers like to make things that seem simple, complicated.

Pamela: Stars are classified based on their temperature, which is a function of the star's mass, radius, and what's going on in its core. Hot stars are massive, blue and never live very long. Red stars come in a lot of different forms, but they are always cool, and the ones we care about today are tiny.

Travis: Astronomers like to give things that seem interesting, boring names. Many people who managed to take college astronomy and stay awake in class remember the mnemonic "Oh Be A Fine Girl, Kiss Me" which stands for the letters O,B,A,G,K,M which are the classifications for stars. The O stars are the biggest and bluest and the M stars are small and red. The Sun is right in the middle, a G star, which is represented with the word "girl" in that mnemonic.

Pamela: A little sexist? We agree. So how about "Oh Be a Fine *Guy* Kiss Me?"

Travis: There's another one: "Only Boys Accepting Feminism Get Kissed Meaningfully"

Pamela: And the best one, from answers.com, "Only Bored Astronomers Find Gratification Knowing Mnemonics"

Travis: (thinking)O,B,A,F,G,K,M. Yup, it works. So what happens when a star is found to be redder than an M?

Pamela: Some astronomers want to call those stars L, or S or just lump them all together with the M's. And there has been great rabble rousing among the astronomer masses over that one.

Travis: Cool stars trend toward the less massive side. At some point, they are so small that they cannot sustain fusion anymore. Perhaps that is where we should draw the line about what to call a star.

Pamela: But there are objects out there, called brown dwarfs, which do not sustain regular hydrogen fusion.

Travis: Our Sun and all other stars burn Hydrogen in their cores for the first and longest segment of their starry lives. Brown Dwarfs never get hot enough to sustain hydrogen burning, but many do burn a special form of hydrogen called deuterium for a million years or so when they first form

Pamela: All brown dwarfs glow thermally -- like Jupiter but brighter -- and for a bunch of weird physics reasons, they are all about the same radius as Jupiter. So this

raises the question of what distinguishes Jupiter from a Brown Dwarf.

Travis: Some would say only the Deuterium burning brown dwarfs are actually stars. This restricts brown dwarfs to objects about 12 times Jupiter's mass and larger.

Pamela: Others drop the size limit even lower, allowing any object that formed out of its own molecular cloud to be a brown dwarf. Most of these folks seem to give a lower boundary of 8 or 10 Jupiter masses.

Travis: This question of "What is a Brown Dwarf" is fundamental to the announcement we report on this week. Charles Lada of the Harvard-Smithsonian Center for Astrophysics has submitted a paper claiming that most stars in our galaxy are alone, just like our Sun.

Pamela: This paper was submitted back in November. Why did they have to issue this press release so close to Valentine's Day? It's so depressing.

Travis: But actually it isn't, the paper suggests that because they are alone, these small stars are more likely to have planetary systems around them.

Pamela: Ah, so our galaxy is home to a bunch of single parents. Take that, Dan Quayle.

Travis: This is a marked change from conventional wisdom, which states most stars are part of multiple star systems. Our Sun is just a rare exception.

Pamela: Conventional wisdom: one of the most dangerous phrases ever to grace the English language.

Travis: This is yet another example of a Slacker Astronomy Law: Whenever we think we're special, we're not. The Sun is actually part of the majority. In fact, Lada says that two-thirds of the stars in our galaxy are single.

Pamela: The aforementioned conventional wisdom stems from observations reported in the scientific literature. Most recently a 1991 study of G type stars, those like our Sun, found that two-thirds of the stars have companions.

Travis: Astronomers extrapolated that percentage to all classes of stars and voila', canonical knowledge, conventional wisdom, call it what you will – it is potentially dangerous sometimes.

Pamela: A year later a paper was published which suggested that different classes of stars may have different rates of companions. Maybe G stars have more companions than lowly M stars, similar to how rich people tend to get dates easier than poor people.

Travis: Are you suggesting that stars are gold diggers?

Pamela: Not at all, just that there are very real distinctions between these classes of stars. So it seems like a long shot to assume the properties of one class applies to all. Scientists are taught to always interpolate, never extrapolate. Yet here we are extrapolating like crazy.

Travis: What enabled Lada to upset the canonical apple cart was a series of infrared

sky surveys. These new surveys are good at detecting red dwarfs - those M class stars from the “Oh be a fine girl...

Pamela: or “Guy”

Travis: ...kiss me”.

Pamela: These surveys are also good at detecting brown dwarfs - those M or L or S or K or whatever class you want to call them - stars. The surveys found tons of them all over the place. The galaxy is littered with red and brown dwarf stars.

Travis: And guess what? The ring finger is clear, they're single! (fanfare)

Pamela: So Lada multiplied the companion rate of G stars by the estimated number of G stars in the galaxy.

Travis: Then he multiplied the companion rate of M stars by the newly estimated number of M stars in the galaxy.

Pamela: He made some assumptions for other classes of stars, so there is considerable uncertainty here. But the end numbers are large so there would need to be some very unexpected companion rates for those other classes of stars.

Travis: And he's not extrapolating. He is interpolating now - because he knows the rates for two types of stars. So the chances of some wild companion rates happening in the middle are not good.

Pamela: In other words, based on our current knowledge, this makes logical sense.

Travis: Continuing our romantic theme of the day, this has a profound impact on stellar nurseries. Models of stellar evolution have been built expecting that most of the time multiple stars are born from the same parental nebula.

Pamela: Fragmentation is the most popular model, whereby a cloud breaks into many small pieces that break into their own small pieces, which break... and so on and so forth until relatively small pieces collapse into a star. That would explain why most stars were thought to have siblings. But now that theory may have to change.

Travis: But the bigger impact of this discovery relates to our estimates of the number of extrasolar planetary systems. So far, most of the extrasolar planets discovered have been in systems with a single star. This is because complex gravitational interactions in multiple star systems tend to make it hard - but not impossible -- for planets to form.

Pamela: And if they do form, they are either far away or very close to the stars. Making life on them unlikely.

Travis: The famous Drake equation combines together a bunch of estimates to determine the likelihood of intelligent life elsewhere in the Universe. One of the elements is the percentage of stars in our galaxy thought to harbor planets.

Pamela: When Drake created the equation that number was thought to be 50%, because at the time he guessed half the stars were single. After this new discovery it could be much higher, maybe up to 66-67%.

Travis: So, a big deal from a simple equation. No telescope required. They just applied good old common sense, which is often all a genius needs.

Pamela: That and an overnight brainstorm session fueled by mountain dew and skittles.

Travis: It still won't be so easy to change the direction of decades of astronomical common wisdom. Expect opponents to bring out the classification debate. Should all of these red dwarfs be counted as stars? We can't even see most of them except with really advanced telescopes because they are so cool and dim. Most of the stars we can see with our naked eye or with simple telescopes do have stellar companions.

Pamela: The nice thing is this debate will be settled by our friend common sense. Just like anything in language, the culture will decide - in this case the *common* in common sense. In a decade most people will be referring to all red dwarfs as stars or they won't. Same with brown dwarfs. A single person won't make the decision, the zeitgeist will.

Travis: Thomas Paine would be proud of this podcast.

Pamela: Glad somebody is.

Travis: And while we're being happy, let's be happy for the good work the folks working on the Katrina Astronomical Fund Drive are doing.

Pamela: Meade instruments has donated a 70mm refracting telescope. We have put it on eBay for auction. Again, you can find the link at our web site. It would be a good starter scope for showing a child the moon and planets. The auction will be over around February 14.

Travis: Our one year anniversary!! What do we have in store for our intrepid listeners?

Pamela: They'll have to wait and see to find out...

Travis: Oh, and we are about to put up another chit chat show on our SA Extra feed. Subscribe to the feed to hear us chat with guests, answer listener mail, play scifi clips and more. The feed can be found on our home page.

Pamela: Well, I'm Travis and for Pamela and our author...

Travis: Wait! *I'm* Pamela and for Travis and our author Aaron, thanks for listening.

Pamela: Clear skies and clear bandwidth. You've been listening to slacker astronomy, a podcast for me..

Travis: You!?!?

Pamela: ...oh I mean you!

Travis: Me?!?!?

Aaron: Guys, you're supposed to keep the voices in your HEAD!

(oceanside clip)

