Asterism: Annie Jump Cannon & Spectral Types

Intro

Jordan: Hi, I'm Jordan.

Kit: And I'm Kit

Jordan: Welcome to Starry Time

Kit: Asterisms Edition,

Jordan: where stars plus lines equals stories

Kit: with an asterisk.

Jordan: In these episodes, we'll explore ideas, concepts, or people that didn't make it into the show or that we just want to talk about a little bit more. In today's episode, we're going to focus on spectral types and our mom's quote "college roommate," Annie Jump Cannon.

Spectral Types

Alright, Kit. Why don't we just start off just describing really broadly what's a spectral

type and how is this concept used in astronomy?

Kit: Excellent. So there are a lot of ways astronomers describe stars. One way is by describing the luminosity, which is how much light is emitted from the surface of the star. And that's measured by total electromagnetic energy emmitted per unit of time by a particular object or star.

Jordan: We discussed luminosity in more detail in our episode eight on Leo. And I remember for that episode that the Sun's luminosity is 3.78 times 10 to the 26th joules per second.

Kit: An amazing memory.

Jordan: I just recite the numbers to myself every day when I wake up. And not like I would have cheated and looked it up at all. No, no, no, nothing like that.

Kit: No. Of course not just really, um, stayed with you.

Jordan: Committed.

Kit: So we have luminosity. Next, there's apparent magnitude, which is how bright something appears from Earth. This is, of course, related to luminosity, because how far away something is determines how bright it seems to us. So something that's dim but really close will seem really bright. And something that's far away has to be really, really bright for us to see it at all.

Jordan: Exactly. And for some reason, this scale is a reverse logarithmic scale. So the

lower the magnitude again, the brighter the star is.

Kit: And the reason for this really does just appear to be tradition. Tradition.

Jordan: Tradition.

Kit: It seems like originally magnitude was ranked as the first is the brightest and the second brightest, and so on. And then once we actually were able to measure it more quantitatively, they wanted to make sure that the quantified number sort of matched this 123 system. And so it kind of ended up with this reverse logarithmic scale allowed them to do that. But it's kind of confusing.

Jordan: Confusing? I don't find anything confusing about it at all. But if you want to know more about apparent magnitude versus absolute magnitude, you can check out our episode seven on Cancer the Crab.

Kit: So, now, at long last, we've gotten to today's topic, which is Spectral Types. So luminosity tells us what kind of wattage a star or other space object is putting out. Apparent magnitude tells us how bright it seems to us. And spectral types tell us about the surface temperature and then relatedly what the color of the star is. But how does it do that? Well, it does that by analyzing the electromagnetic radiation from a star and how the light is absorbed in various ways, which is determined by the chemical composition of the star.

Jordan: So this idea of a spectral type, it summarizes actually a lot of information about a star beyond just how bright it is.

Kit: Mhm.

Jordan: Spectral types are usually classified with the letters O, B, A, F, G, K and M.

Kit: The traditional mnemonic for memorization is oh, be a fine girl or guy, kiss me and I don't care for it.

Jordan: Yeah, no, I prefer if we just said it like it's written OBAFGKM . So we'll workshop on it maybe?

Kit: Yeah, we can put it on the Retcon list.

Jordan: These spectral types are associated with temperature, where O types are hot blue, violet stars and M, are very cool and red or orange in color. And within each letter they rank from 0 to 9, with those closer to 0 as hotter and those closer to 9 as cooler. So our sun has a temperature of about 5,800 Kelvin. It is yellow in color, and so it's classified as a G2 star.

Kit: In general, astronomers think type F, G and K stars are the most likely to have habitable planets around them.

Annie Jump Cannon

So let's keep rolling. Now we have the big picture. Do you want to tell us about the Harvard

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classification scheme and Annie Jump Cannon, Jordan?

Kit: Of course, Annie Jump Cannon lived from 1863 to 1941, and she was born in Delaware.

Kit: You don't hear people born in Delaware very often. It's very small state.

Jordan: And Annie Jump Cannon attended Wellesley College in Massachusetts, where she studied physics, astronomy, and graduated, of course, top of her class.

Kit: Mhm. At Wellesley College, she worked with Sarah Frances Whiting, who was Wellesley's first professor of physics, and, uh, mentored and taught some other notable women astronomers.

Jordan: You love to see it. Wellesley long legacy here. So what does Annie Jump Cannon have to do with spectral types?

Kit: Right to the heart of the matter. There is a lot of great biographical information about Annie Jump Cannon out there. And she actually had quite a long career in astronomy. She's probably best known, however, for working with Edward C. Pickering to work on a star catalog funded by Henry Draper. She was hired as a quote, computer along with other women. And in this capacity, she manually cataloged over 350,000 stars.

Jordan: That's an incredible amount of stars. 350,000. But all right, what does

cataloging involve though?

Kit: So this is a good question. And my understanding is that during this time period, men operated telescopes and took pictures of stars. Which sounds fun. And then these women computers, including Annie Jump Cannon would look at the data, do the astronomical calculations and analyze the spectral patterns and then organize the data.

Jordan: Less fun.

Kit: No, not as much fun.

Jordan: But she did this for 350,000 stars.

Kit: Yeah. Incredible. She was really good at it. And her biggest contribution as she was doing this was the creation of this seven letter system that we discussed earlier.

Jordan: Which we all remember is O, B, A, F, G, K, M. Before that system though, the classification system was even more chaotic.

Kit: Mhm.

Jordan: Basically one of the earliest use of spectra to organize star classifications was created by Angelo Secchi, which created five classes of stars. And then it was followed by the original Draper system created by Williamina Fleming, who was a colleague of Annie's, which created a letter system of A through Q relating to hydrogen lines in the spectra. There was some alignment there that overlaped with Secchi's work. But for example, stars classified A or D were all type 1. Another colleague of Annie's working at

the same time, Antonia Maury or Antonia Maury, proposed yet another type of system. But ultimately it was Annie Jump Cannon who refined both of these into the simpler system which became the Harvard classification that is mostly the same as it is today.

Kit: Yeah, and so some of the reason for this strange ordering of letters is because of this collapsing and refining of these other existent systems at the same time.

Jordan: Yeah, that makes sense.

Kit: Since the development of the system, it's been modified and extended in various ways, even though this Harvard classification scheme, as you mentioned, is pretty well intact. Um,

Extended Spectral Types

so to wrap up this little asterism, I just want to read out some of the names, uh, and a little bit of information about these extended spectral types and you can tell me which one you think sounds best. What do you think?

Jordan: Sounds awesome. Let's go. Hit me with the names.

Kit: All right, let me uh, get my document open here. I don't have them memorized, so apologies to everyone.

Jordan: So that's quite disappointing because I repeat 3.78 times 10 to the 26 joules per second daily. Due to my dedication to the pod, and you can't even remember a few

extended spectral types?

Kit: So.

Jordan: Says a lot about your commitment.

Kit: So we now know about these cool red and brown dwarfs, um, and these have been added to the list of spectral types so now we have class L, class T and class Y stars. And these are all um, cool red and brown dwarf classes. We've got peculiar brown dwarfs. We have added class C which are carbon stars, red giants that are towards the end of their lives. We've got S stars which are sort of like between a carbon star and an M star. We've got also ah, class W stars which are Wolf Rayet stars, um, which are sort of hot and blue stars. They used to be O stars and now they're W stars. We've got but slash stars which are O, slash W or WN stars. We've got magnetic, we've got a lot of them. Do you like any of them? Did you see

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Kit: other ones that you really liked?

Jordan: You haven't even mentioned my favorite which is the white dwarf classification or the class D which stands for degenerate star which is the modern classification used for white dwarfs which are low mass stars that are no longer undergoing nuclear fusion and have shrunk to planetary size slowly cooling down. So yeah, there's a lot of great options here. Class S the slash stars, the peculiar brown dwarfs, but no the class D degenerate white dwarfs.

Kit: Yeah I also those one that's a great choice. I liked all of the really like class L, T and Y these sort of really subtellar objects that are kind of interesting and sort of hidden. We've talked about them before on the pod with Teegarden's Star and those kinds of things. So yeah there's, we're just sort of using the rest of the alphabet and maybe one day we'll run out of alphabet. Yeah, so definitely Let us know, take a look at the extended spectral types and let us know what your favorites are.

Outro

Jordan: Thank you for joining us today for this asterism on spectral types and Annie Jump Cannon.

Kit: This has been Kit

Jordan: and Jordan

Kit: Sisters. Lovers of stars and stories.

Jordan: And we'll see you next time

Kit: on Starry Time.

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