

[00:00:13] Jordan: Hi, I'm Jordan.

[00:00:15] Kit: And I'm Kit.

[00:00:17] Jordan: Welcome to *Starry Time*, where stars plus lines--

[00:00:20] Kit: Equal stories.

[00:00:22] Jordan: In this episode, we'll be focusing on the astronomy and cosmic background of the constellation Sagitta "the Arrow".

[00:00:31] Kit: And just so we're all clear, Sagitta is indeed a different IAU constellation than Sagittarius "the Archer".

[00:00:39] Jordan: Who we covered in season one and who launched Kit's podcast, Extended Universe.

[00:00:45] Kit: Yes, it does include some pretty critical story time lore. If you haven't listened to the Sagittarius episodes, you're going to want to. **[00:00:53] Jordan:** Time to go back, but yes, Sagitta "the Arrow" is a completely different constellation, one that is perhaps a bit less famous. Not a zodiac constellation, and it is in fact significantly smaller, coming in at 79.9 square degrees, making it the 86th out of the 88 IAU constellations. In terms of size.

[00:01:22] Kit: We haven't covered a smaller constellation to date.

[00:01:24] Jordan: So good for you, Sagitta. Welcome onto the board.

[00:01:29] Kit: In perhaps somewhat surprising news, Sagitta was in fact one of Ptolemy's great.

[00:01:35] Jordan: Great. [onomatopeia]

[00:01:40] Kit: Constellations identified in the Almagest back in the 2nd century, where it was actually called the Greek word for arrow rather than the Latin word as it's currently described.

[00:01:49] Jordan: Not another of Hevelius Link projects, which we can be thankful for. Although perhaps Ptolemy had Link's vision. In order to see this 86th out of the 88th constellations.

[00:02:02] Kit: Let's get into our first impressions and where one could find this little baby arrow. What did this one look like to you, Jordan?

[00:02:09] Jordan: Not only did they find it, they nailed it. This is one of the simplest ones I have seen. It could be an arrow, it could be the Eiffel Tower taking a nap, it could be a badminton thing. What do they call it? The shuttlecock. But no, it's a pretty simple constellation. To me, either looks like an arrow or a really simple math equation, I guess, of two intersecting lines meeting in the middle. I don't know. What does it look like to you, Kit?

[00:02:39] Kit: I dont really see arrow. It kind of looked a thong sandal or like a sling

that you could throw stones with like a distorted Y shape. I guess it is closer to arrow than the river looking constellation Links is to Wildcat. I mean, yes, it's not not an arrow, but it wasn't immediately an arrow to me.

[00:03:04] Jordan: Well, for once we had different first impressions because to me, shoot, if I drew an arrow constellation, it would look just like this.

[00:03:13] Kit: Yes. Let us know over at Storytime pod on the Universe dawn server on our socials. Let us know what you think. Did you see the arrow? Would you draw this as the arrow constellation? We need the folks to weigh in here.

[00:03:26] Jordan: Finding this constellation is a bit difficult because as we mentioned before, not only is it quite small, it's also pretty dim. But for now, let's get technical.

[00:03:39] Kit: We love to be technical.

[00:03:41] Jordan: I missed getting technical. This constellation is a northern constellation. It's visible across most of the globe and it's located in the night sky around 20 hours right extension and 20 degrees north declination.

[00:03:57] Kit: The best time to see this constellation in the night sky is in August, and you can find it by looking for Cygnus in Lyra.

[00:04:03] Jordan: Shout out to two constellations we covered in season two, Quests and Curses.

[00:04:09] Kit: The constellation is south of Cygnus and Lyra, though its most northern neighbor is actually Vulpecula.

[00:04:17] Jordan: Vulpix? The Pokemon Vulpix. They have Pokemon
[unintelligible 00:04:22]

[00:04:23] Kit: I wish. Yes, Sagitta is also close to Hercules and Akilah the Eagle, which is central to at least one of the myths related to this constellation that we'll talk about next time.

[00:04:35] Jordan: Spoilers though, if you're curious about our guy Hercules, we got you covered. Season 2. Give it a listen.

[00:04:43] Kit: That catalog, it's ever growing and ever important. One other important thing to note here about where this constellation is in the night sky, uh, before we get into notable stars, is that the band, the Milky Way and the so called Great Rift are visible in this part of the night sky.

[00:05:00] Jordan: Yes. If you're lucky enough to be somewhere dark enough to see this constellation, you'll be treated to an absolutely stunning view. Now we know sort of what this constellation looks like and where to find it. Now let's talk about the stars.

[00:05:15] Kit: This constellation only has four main stars and not a single one of them is brighter than a third magnitude star.

[00:05:22] Jordan: Pretty dim constellation stars here, so I'm scared to ask if Bayer's back on the job.

[00:05:29] Kit: Well, Bayer was indeed back on the job, but he actually identified eight stars, Alpha to Theta in the constellation Sagitta. This might have been perhaps his greatest challenge and sad trombone, he didn't get it right. The brightest star in the constellation has the barrier designation Gamma Sagittae and Alpha is actually the third brightest star with a visible magnitude of only 4.38.

[00:06:01] Jordan: Third brightest, I mean, out of his proposed eight that's close, right?

[00:06:08] Kit: Well, Gamma Sagittae actually has a visible magnitude of 3.47, so it's not super close, though.

[00:06:15] Jordan: Not great.

[00:06:16] Kit: What we do know about Gamma Sagittae, is that it's a single star, unlike the binary and multiple star systems that we're often talking about, and this is actually the star that's the tip of the arrow. It's a red giant star that's about half the age of the sun at 2.3 billion years old, and it's around 275 light years away from us. And it's actually moving toward us at a rate of about 34 kilometers a second, which would be 21 miles a second.

[00:06:45] Jordan: As a red giant that's younger than the sun, it's got to be way bigger than the sun, at least at this point, right?

[00:06:51] Kit: Precisely. It's about 58 times the radius of the sun in that red giant phase, but the mass is either around the same as the sun or up to twice as massive, depending on who you ask.

[00:07:03] Jordan: Still more to discover, but all right, Gamma Sagittae, solo star doing that red giant thing, much like our own sun will.

[00:07:12] Kit: Yeah, eventually it'll become a white dwarf star, much like our own solo sun. And honestly, that's pretty much all I could find out about this one.

[00:07:20] Jordan: That's all right. We got some facts.

[00:07:21] Kit: Let's get now to our segment, Bayer's Variable Star, where we move through the Greek Alphabet in order, usually, to learn more about another Bayer designated star in the night sky. This week we've got Delta Sagittae on the agenda. What did you find out about this one, Jordan?

[00:07:39] Jordan: Well, I'm glad you did say usually. I didn't want to say anything too early, but Kit, even though Delta Sagittae is the second brightest in the constellation, that's about all I really found out about it. Time for another left turn here, and I'm going to try to sneak in another star under the variable star loophole.

[00:08:03] Kit: The what now?

[00:08:04] Jordan: Kit, this isn't just called Bayer's star. The segment is called

Bayer's Variable Star, isn't it?

[00:08:12] Kit: Yes.

[00:08:13] Jordan: Well, by-laws clearly state that variable stars, whether or whether they not they follow the Bayer designations, can take precedence in the event of a not very compelling alternative.

[00:08:26] Kit: What by-laws.

[00:08:28] Jordan: Kit, of all the people not to know the by-laws, I'm somewhat disappointed.

[00:08:36] Kit: Well, I guess who am I to argue with imaginary by-laws?

[00:08:40] Jordan: Don't start now, okay?

[00:08:44] Jordan: Instead of Delta Sagittae, I'd like to introduce you to WR124. Recently imaged quite dazzlingly by the James Webb Space Telescope. WR124 is what's known as a Wolf-Rayet star.

[00:09:01] Kit: Wow. Technicalities abound here, since a Wolf-Rayet star is technically a variable star in the eruptive subtype, but is in another category of stars with an irregular brightness. This is a very variable variable star.

[00:09:20] Jordan: Kit, we're on Season 3. It's time to get very, very variable. WR124 is a Wolf-Rayet star, I'm not sure how I pronounce it, and it's one of the fastest runaway stars we know about. It's moving at about 124-ish miles per second, or about 200km per second for our international listeners.

[00:09:47] Kit: Making Gamma Sagittae look like a slowpoke. Oh, my gosh.

[00:09:52] Jordan: And as seen in the James Webb Space Telescope, it is surrounded by a beautiful nebula called M167 that is expanding and it's nearly six light years across.

[00:10:05] Kit: Yes, this image is really, really beautiful. I would say this is a good use of the imaginary by-laws. I can admit it. I'm a big enough person. I think we should take a quick break here so everyone can go admire WR124 before I try to follow up this very important variable star loophole and give you my Gold star from Sagittae.

[music]

[00:10:39] Jordan: Welcome back. This segment is called Gold Star. In this segment, we alternate picking the star or space object in our constellation of the month that captures our mind, our heart, perhaps even our soul. What was your pick this month, Kit?

[00:10:59] Kit: Despite being small, Sagitta has a Messier object as well as some other interesting stuff going on in it. First and foremost, there are a number of variable stars, including WR124 as just discussed, as well as variables of the

Cepheid and cataclysmic variety. There's a lot of variable stars in this small little constellation and it also has a few stars with Jupiter sized planets around it.

[00:11:25] Jordan: We love an exoplanet, even the exoplanets that definitely would not be hospitable to us human life, but I'm guessing this isn't where you went with this one.

[00:11:37] Kit: In the end, for me, it really came down to two choices, and both of them are planetary nebulae. As much as I'd love for your immediate reactions on Ralph Copeland's beard, who discovered one of the options called NGC 6886, that's going to have to wait because my gold star of the month is the Necklace Nebula, also called PN G054.2-03.4

[00:12:10] Jordan: It's like something out of the Dewey Decimal system over here. All right, I did look up Ralph Copeland's beard and it's very 19th century, gives me some real Rutherford B. Hayes energy. Scraggly, extensive. Can't imagine it's particularly pleasant for smell.

[00:12:38] Kit: Gross. Anyways, the Necklace Nebula is a planetary nebula about 15,000 light years away, and it was actually discovered in 2005 using a ground based telescope that was named after Isaac Newton.

[00:12:52] Jordan: That's amazing. This is maybe the most recently discovered and named object we've talked about since starting this pod, Kit.

[00:13:00] Kit: Yes, it's definitely one of the newer things for sure, and it's called the Necklace Nebula because it indeed looks like a necklace.

[00:13:07] Jordan: Keep it simple. Astronomers nowadays, some of them, they need to make up for the ancient astronomers getting a bit, let's just say, creative with their constellations.

[00:13:19] Kit: You don't see Sea goat.

[00:13:21] Jordan: It wouldn't be my first guess, no. I see actually more of a necklace in the sea coat in Capricorn is than I do a sea goat, but that's just me.

[00:13:34] Kit: This planetary nebula was created by a star that was actually probably pretty similar to our sun, except it was part of a binary system. These two stars were orbiting really, really close together, and as they started to move through their life cycle, they began expanding into their red giant phase. The larger of the two swallowed up its companion star in what astronomers call a common envelope.

[00:13:58] Jordan: Yeah, just a common envelope. Just when one red giant just eats the other. We've all seen it. We all know.

[00:14:05] Kit: Exactly. With all that extra fuel in that common envelope, the star started to spin faster and faster and faster, causing the gas around the star's equator to expand into space in a roughly ring shape. You'll see in images of this nebula, there are some areas that are brighter and resemble jewels, which is the result of denser areas of gas that were flung away as the spinning was happening. These two stars are still orbiting each other in the center of the Necklace, but they orbit so

closely that they complete their orbit in about 1.2 days and are only a few million miles apart from one another.

[00:14:40] Jordan: I know we've talked about other planetary nebulae before, but the specific formation of this one and the resultant nebulae, I have to consider this an excellent addition to the Gold Star of the Month Club, Kit. This brings us to the end of our exploration of the cosmic background of the constellation Sagitta. Next week, we'll be retelling and ret constellationing the myths of this constellation.

[00:15:11] Kit: This has been Kit-

[00:15:13] Jordan: And Jordan.

[00:15:15] Kit: Sisters who love stars and stories.

[00:15:19] Jordan: We'll see you next time--

[00:15:20] Kit: *On Starry Time.*

[music]

[00:15:40] [END OF AUDIO]