Episode 10: Magic 8 Ball vs. Mira
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Travis: Welcome to Slacker Astronomer, a podcast about astronomy and anything else that floats over our heads.

Pamela: Each week we will bring you a recent news event from the world of astronomy. And when nothing is happening, we'll ask the magic 8 ball of life whether it is worth continuing the show or not. Magic 8 ball, should we continue? (SHAKE) "Better not tell you now."

Travis: Tease!

Pamela: Before we dive into our witty repartee, we have a brief primer on stellar magnitudes.

Travis: The brightness of a star is measured in magnitudes. It is a complicated system that everyone hates, but it is established so we stick with it like good stubborn mules.

Pamela: With magnitudes, the lower the number the brighter the star. So a magnitude 1 star is brighter than magnitude 2.

Travis: The system is logarithmic, not linear. So that mag 1 star is *not* twice as bright as the mag 2 star.

Pamela: In the case of stellar magnitudes, it is actually 2.5 times brighter.

Travis: Yes it is counterintuitive. We have Hipparcos to blame. But hey, he started the system in 129BC, back when people were still using leeches.

Pamela: This is what happens when Mathematicians are allowed away from their abacuses. Bad nerd! Bad nerd! No Farscape for you.

Travis: The human eye can see to magnitude 6 under pristine dark skies. With binoculars you can get to magnitude 10 or so and with a backyard telescope to magnitude 14, depending on its size.

Pamela: I hope you remember that, it will come in handy later in the show. Ready to begin, Travis?

Travis: Once sec, let me stretch. (stretching grunts). Okay, now for the vocal warm ups. "Around the rough and rugged rock the ragged rascal randomly ran." Now for a brain warmup: "The volume of a cube is length times width times height. The Fonz jumped over the shark in episode #91." Okay, ready! What are we lieing - I mean, learning about today?

Pamela: Omicron Ceti.

Travis: The planet in Star Trek?

Pamela: It is also known as Mira the Wonderful.

Travis: That's a pretty name. Does it live up to its hype?

Pamela: Mira is the common name for the star Omicron Ceti. It was referred to as Mira the Wonderful by Johannes Hevelius of Danzig, Poland in 1642. He was commenting on an interesting trait of the star — its brightness appears to slowly and rhythmically change. This is something anyone can see. You don't even need a telescope, binoculars, or even dark skies. You can even be in a city. Well, most cities. Maybe not from Manhatten.

Travis: The catch is that it takes a long time to pulsate; almost a year.

Pamela: At its brightest, Mira is one of the 50 brightest stars in the sky. If you have a star chart, it is easy to find. We have one in the Show Notes at slackerastronomy.org. At maximum, it is at magnitude 2-3. At its faintest, it dips to magnitude 10. About 630 to 1500 times fainter!

Travis: In about 165 days it becomes so faint that you need a telescope to see it.

Pamela: A backyard telescope will work, but you need a telescope nonetheless.

Travis: And 165 days later it reappears to your unaided eyes, and it's back to being one of the brightest 50 stars.

Pamela: This regular change in brightness was first discovered in 1596 by David Fabricius of East Friesland, Germany. Although there are possible reports that other societies in China and Korea noticed it much earlier, Friesland gets credit because his documentation is the earliest to have survived.

Travis: Ah, bureaucracy finally has a purpose!

Pamela: History and bureaucracy are a match made in Heaven.

Travis: Let's ask the Magic 8 Ball. "Was Fabricus the first person to discover Mira the Wonderful?" (shakes) "Reply hazy, try again."

Pamela: Hmm, the Magic 8 Ball would make a good politician.

Travis: No way, the Magic 8 ball does not lie.

Pamela: Why are we talking about a discovery made 400 years ago? Isn't this podcast supposed to be about recent astronomical news?

Travis: Well 1596 is recent on the astronomical scale of things.

Pamela: But not recent enough for our short attention sp... (bells) woah! look! shiny object!

Travis: Once again, let's turn to the mighty 8 ball. "Why are we doing a show about Mira the Wonderful?" (shakes) "Outlook not so certain."

Pamela: Good answer. We don't even have an idea where this show is going.

Travis: Downhill - and fast. (chipper) As usual!

Pamela: But we already started at the bottom.

Travis: We're sinking so low that we'll form a singularity soon.

Pamela: Nerd humor. I like it.

Travis: Hear that guys? Pamela likes nerd humor. If you have nerd humor jokes send them to pamela@slackerastronomy.org.

Pamela: And include a picture.

Travis: Preferably of you. But that isn't required.

Pamela: Imagination is a wonderful thing.

Travis: Magic 8 ball, will Pamela ever settle down? (shake) "Without a doubt."

Pamela: Magic 8 Ball has my back! (kisses the 8 ball)

Travis: Hey, gimme that! I've never seen a black 8 ball turn red before.

Pamela: Speaking of red, Mira the Wonderful is a type of star called a Red Giant. It even looks red to the naked eye.

Travis: We give you the award for the best segue in SA history. I humbly bow before thee.

Pamela: Aaron wrote it.

Travis: (snobby accent) Aaron wrote junk! Incomprehensible banal gibberish ad infinitum! You, my lady, turn it into (pronounced carefully) poetry.

Pamela: (cocky) Well, yeah. You know. I'm good. Hmmm, we ruined that wonderful segue with quite a digression. I see Aaron is now in the corner crying in a fetal position.

Travis: Don't worry about that. That is his normal state during taping.

Pamela: (clears throat) Ahem! Okay, Mira the Wonderful. Act II. (wooden clap) Action!

Travis: You may remember we talked a little about red giant stars in Show #6 about Sakurai's Object.

Pamela: Red giants are swollen stars near the end of their lives. They have helium or heavier elements like Carbon in their core and Hydrogen or other light elements in shells around their cores. Out side of these onionskins of atomic fusion is a tenuous envelope of Hydrogen that is barely held together by gravity.

Travis: Compared to our Sun, red giants are also very cool. Mira's surface temperature varies from about 2200 to 3000 Fahrenheit or 1200 to 1600 Celsius. Cooler temperatures mean redder color. Thus, our hot Sun is yellow in color and Miras are deep red.

Pamela: It is the Miras' cool, weak outer envelope that pulsates in and out. This beating isn't symmetrical. Different parts pulse at different times and rates. An animation of a pulsating red giant looks a little like a pumping human heart. The pulsation mechanism is not precisely known and is an area if intense research.

Travis: Red giants are not only cool literally, but also figuratively. They slowly and, for the most part, steadily pulsate in the night sky. At their maximum size, these stars can be 300 times the size of the Sun.

Pamela: Mira stars are also windy, and the winds drive a process called mass loss. Basically the star is blowing itself away. After a million years the stars atmosphere will have abandoned the stellar core entirely, leaving a white dwarf surrounded by a planetary nebula.

Travis: Red giants are the steady, cool headed, laid back jazz aficionado cousins of the fiery tempered, big haired, rock n roll lifestyle living hot blue giant stars.

Pamela: Because they are cool and red, they radiate a lot of light in the cooler infrared spectrum.

Travis: In fact, some red giants are so bright in the infrared that they can be seen in the daytime — if you are using an infrared telescope.

Pamela: But they get dimmer as you move down the spectrum into the shorter, bluer wavelengths. By the time you reach really short wavelength like X-Rays, you shouldn't be able see the stars at all.

Travis: Or so we thought. X-rays have recently been detecting from Mira - her wonderful surprising self.

Pamela: Mira, a bright single star as seen with the naked eye, is actually 2 stars that are very close together. You need a telescope with very good resolution, like the Hubble Space Telescope in space to separate the two.

Travis: The star Mira A is the red giant, and other star, every so eloquently named Mira B, is thought to be a small white dwarf.

Pamela: While white dwarves are small in radius they are huge in mass. The typical white dwarf is the size of the Earth but is about the mass of the Sun. It has an intense gravitational field because it is so dense. In Mira's case, the white dwarf is pulling material from the surface of the red giant. The material forms a bridge to the white dwarf.

Travis: As the material falls, it forms a disc due to the conservation of angular momentum. This is the same rule of physics that makes pizza dough flatten out when it is thrown into the air spinning.

Pamela: As material streams off the red giant and toward the white dwarf, it moves in progressively smaller orbits, and it must speed up as its orbit shrinks to conserve momentum.

Travis: This is the same physics that makes an ice skater rotate faster when she draws in her arms.

Pamela: Add to this orbiting material some friction and turbulence and you get an accretion disc — a white-hot glowing disc spinning around the white dwarf. It is so hot that it gives out X-Rays.

Travis: We first detected X-Rays from the accretion disc in the Mira system decades ago. What no one saw until now was X-Rays coming from the red giant itself!

Pamela: Dr. Margarita Karovska (kor off ska) has been studying this star for over 20 years. Using the Chandra Space Telescope, which is quickly becoming the favorite observatory of Slacker Astronomy, she detected two cool things about it. First, the bridge of mass transfer between the two stars has finally been directly imaged. Secondly, an unexpected outburst of X-rays was detected from the red giant. This has never been seen before in a star of this type and has sent many astrophysicists back to their slide rules and abascuses.

Travis: Our own Sun has X-ray flares every now and then. Often they are associated with ejections of mass from the Sun that can cause aurorae if they strike the Earth. On our Sun, such flares last from seconds to hours. On Mira, this flare is expected the last from weeks to months!

Pamela: The cause of the flare is unknown, but the leading theory blames mass ejection. If this theory's true, then we may be in for some excitement with Mira during the next year. The ejected material may turn into dust and make the system dimmer and a deeper red color. Or it may impact the accretion disc of the white dwarf and excite it, making it brighter and bluer in color! Who knows?

Travis: I know who knows.

Pamela: No, not the...

Travis: Magic 8 ball, will Mira get dustier and redder this year? (shake) It is certain. Interesting! Okay, will Mira get bluer and brighter this year? (shake) As I see it, yes.

Pamela: Contradicting statements! It *is* a politican!

Travis: No, it is saying that it will be both red and blue - a purple star!

Pamela: Oh my. Well, you'll be able to see for yourself because any change is likely to happen this year. Astronomers all over the world are monitoring Mira to see if anything happens.

Travis: How come there are no purple stars? Or green, why no green stars?

Pamela: That is a good question that we'll answer in a future Monolithic Monologue on the Slacker Extra feed.

Travis: Speaking of which, tune in to the Slacker Extra feed on our web site for an interview with Dr. Jonathan McDowell, who actually works with the Chandra Space Telescope. He is an expert on space exploration and talks about rockets, spy satellites, orbital mechanics, how to watch the International Space Station pass overhead and more.

Pamela: But while your listening to this show, we'd like to thank everyone for helping us raise $300 in donations to purchase better sound seeing tour equipment. We have our gadgets in our hot little hands. Expect much better shows in the future.

Travis: Also thanks for the Podcast Alley votes. We peaked at #4! This will look good on some grant applications we are sending out.

Pamela: Funders love numbers - so anything we can do to quantify success helps.

Travis: We don't plan to formally ask for podcast alley votes again, but of course it wouldn't hurt if you did it on your own. Insert a mind's eye smiley emoticon here.

Pamela: Remember when emoticons were new and everyone had printed handouts of emoticons next to their computers?

Travis: No.

Pamela: Okaaaayy. I think we should end this podcast before my hair gets any more gray.

Travis: Magic 8 ball, should we end the show now? (shakes) Yes, definitely.

Pamela: I like having a Magic 8 Ball as a director. If we don't like what he says, we just shake him. Do you think that will work on Aaron?

Travis: No but I think the last two star wars movies would have been better had Lucas used a magic 8 ball.

Pamela: On behalf of Aaron and Travis, this is Pamela Gay.

Travis: Clear skies and clear bandwidth. This has been slacker astronomy, a volunteer collaboration for you, for fun, for the voices in our heads.