Episode 7

"Extra Solar Planets"

Meta

Dramatis personae

- Ben Tippett
- Ryan North
- Rupinder Brar
- Joanna Woo

Copyright

The Titanium Physicists Podcast www.titaniumphysics.com
Transcription by Gareth Eason (gareth.eason@signal2noise.ie, who should be blamed for any and all transcription, spelling and grammatical errors.)

Timeline

00:00 - Intro

Ben: Over the course of my studies in theoretical physics, I've travelled across the continent and around the world, sampling new ideas, and tasting different answers to the questions of how, and of why. And still, I find there remains a deep hunger which lives within me - a burning desire to share these great ideas with the people around me. And so, I have assembled a team of some of the greatest, most lucid, most creative minds I've encountered in my travels, and I call them: My Titanium Physicists.

You're listening to the Titanium Physicists Podcast, and I'm Ben Tippett.

And now... allez physique!

01:10 - Theme tune

[Intro song; Tell Balgeary, Balgury Is Dead by Ted Leo and the Pharmacists]

01:48 - Kepler 22b

Ben: In December 2011, NASA scientists made an amazing announcement. The Kepler space mission discovered a planet orbiting a star roughly the size of our Sun. The planet they named "Kepler 22b" is about 2.4 times heavier than the Earth. This planet lives within the Goldilocks zone, a region close enough to the Sun for ice to melt into water, but not so close that all the water evaporates. Now although it's 600 light years away from us, this discovery marked the first Earth-like planet discovered outside of our solar system, and the first possibility for extrasolar life. Today we're going to be talking about detecting extrasolar planets.

My guest today is Ryan North from Dinosaur Comics and he's the Duke of the internet. He lives at www.qwantz.com and he's very handsome and he wants everybody to be aware of it. Hi Ryan.

Ryan: Hello. How are you?

Ben: I'm good. How's it going?

Ryan: Good. Good.

Ben: Sweet. Alright, So Ryan, I have assembled today for you, two of my very best Titanium Physicists. Arise Dr. Rupinder Brar!

Rupinder: [Pew! Pew! Pew!]

Ben: Oh! Lasers! Dr. Rupinder did his undergraduate at the University of Toronto, his masters at the University of Waterloo and his PhD at Queens. He's now a senior lecturer at the University of Ontario. Now arise doctoral candidate Joanna Woo.

Joanna: [Clip-Clop Clip-Clop Clip-Clop. Neigh!]

Ben: Oh Wow! That's amazing. How did that horse get in here? Joanna did her undergraduate at QBC and then her masters at the Hebrew University at Jerusalem where she's now doing her PhD.

Alright guys, let's start talking about planets around stars that are far away and how we can see them.

3:27

Rupinder: Well I think the first thing to do is to put into context what a difficult problem this is. So the first planet discovered outside of our own solar… outside of the eight or nine in our own solar system was only discovered in 1995, and the reason is because it's really hard to see these planets. I use this analogy sometimes in my class that if we shrank the size of the sun down to a grapefruit, the next nearest star would be on the other side of the continent. Whatever continent you're on is fine. And now think about it in this sense: You're not looking for that grapefruit. You're sitting in Toronto; you're looking in Vancouver for a grapefruit - you actually want to look for something about the size of the tip of your pen located a few centimetres to maybe a metre or two away from that grapefruit. Oh yeah, and also the grapefruit is really really bright and the pen tip is not.

Ryan: This is what I've understood just from popular media descriptions of this - and tell me where I'm wrong because I'm probably wrong: When you're doing this test to find a planet, if I understand it, there's two things you can look for: one is wobble in the star - slight wobble from the planet sort of pulling it left to right as it goes around - and the other is maybe looking for a spot moving across the planet should the planet happen to be in our line of sight between us and the star and block it out really briefly as it passes. Is that true?

Rupinder: That's exactly right.

Joanna: Actually, you've identified two of the major methods of detecting extrasolar planets and that is essentially correct, except the second method is not so much detecting a blob going across a star but a lowering in the amount of light we see from the star.

Ryan: Right. Because we just don't have the resolution?

Joanna: Exactly!

Ryan: Okay.

5:04

Ben: So, it turns out there are two distinct kind of classes of ways we can detect extrasolar planets. One of them involves looking for evidence of planets - so seeing the shadow, so seeing the diminishment of light as the planet crosses the far away star and eclipses us, or looking at the planet's wobble. Alternatively you can actually take photographs of the planets when they're far away from the star.

Rupinder: Yeah, it's possible. And it's only been done in a very very few circumstances. But essentially what the deal is is that planets are relatively bright in the infrared part of the spectrum and typical stars are actually quite dim, relatively speaking, compared to their brightness in other parts of the spectrum. And so, if you have those circumstances as well as a star that might not be too bright and planets that are very very big and very very far away from their host planet [read "**star**"] you can possibly take a picture of that planet. But it's rare.

Ryan: So it's no accident that the first sort of far away earthlike planet we found is so enormous. It was two and a half times the size of us, right?

Rupinder: This is actually one of the smallest planets we've ever discovered. [Really?] Yeah. It turns out that each and every method that we've come up with to detect planets around other stars are biased towards big planets. In fact, usually they're biased towards big planets that are close to their parent star. And so if you look at the overall number of confirmed planets now - we've discovered, let's see what was the last count here: 725 confirmed planets outside of our solar system - the vast vast majority of them are Jupiter size or even larger than Jupiter. And for at least a short while one might suspect that that means that mostly planets aren't like our solar system. That probably that our solar system is a little strange in that, in fact we see a lot of larger planets closer to their parent star than we see here in our solar system. But what we're starting to see actually is that it's a bias. It's a bias of the techniques that we've been using so far. And that actually maybe our solar system, you know, might be typical and these discoveries that we've made so far are the strange ones.

7:16

Ryan: Right, because we're picking the low hanging fruit which is the giant, comparatively [Exactly!] easy to spot, planets. This planet - this one we're talking about - it's Earthlike: we're saying that because it's in this Goldilocks zone. Is that the only reason we say it's Earthlike? Because it's in the right spot?

Rupinder: And its mass has something to do with it as well. So, it's classified as what we call a Super Earth, which is an unfortunate name.

Ryan: So it's like Krypton? [laughter]

Rupinder: Exactly. It's exactly Krypton. It should just be called a fat Earth really. It's in a really interesting spot, because it's a couple of times larger than the Earth and we don't have a comparison planet. Because it means it's significantly larger that the Earth but significantly smaller than Neptune. And so what kind of planet lives between those two sizes? We actually don't have a good sense of what this planet is going to be like. But what we do know is that it is a distance away from its parent star that probably means that the average temperature on the surface of the earth [read "**planet**"] is about 20°C, which is nice, yeah.

Ryan: So it's a big surface area planet. Because it's 2.5 times the mass - when you say size it's mass, right? So that means more than 2.5 times the surface area doesn't it, because that's how spheres work or am I wrong?

Joanna: From what I understand it's actually the size, so I believe that means its radius.

Rupinder: No. She's right - I'm sorry. It's about two and a half times the radius. Right now the mass is unknown. Due to the way that they detected the [planet.] The method, which is called the transit method. Essentially what happens in this case is we've got a telescope and in this case it's the Kepler spacecraft which is specifically designed to go into outer space and look at thousands of stars in the Milky Way at the same time. And it just sits there. It just sits there staring at the stars waiting for some sort of fluctuation in the brightness of the star. And it will try to detect that fluctuation and see if it corresponds to essentially a circle going in front of the parent star, i.e. a planet. The brightness of that planet[read "**star**"] going down and then coming back up as that planet finishes its transit of the star. With that amount of information we have a good sense of how large the extrasolar planet is. We won't actually get solid mass information until we use the other concept, which is what astronomers would call the radial velocity method or the Doppler method.

10:00 - Kepler

Joanna: Before I get into that, I wanted to explain why Kepler, for example, is looking at hundreds of thousands of stars, and one of the reasons is because planets are going to be orbiting their stars at random angles with respect to the Earth, so very few of them will end up oriented in such a way so that the planet passes in front of the star with respect to Earth. So, in fact, if you just do random geometry, less than 1% of planets will be crossing in front of the star. So you need to look at hundreds of thousands of stars in order to get such a pattern of dimming of starlight.

Ryan: Is there some way to fix that? Like, in the future can you imagine... are we always going to be stuck with just knowing there's only this 1% of stars we can hope to see with this?

Rupinder: There's no way to fix that using this method, but the other methods that we have to detect extrasolar planets should get better and better as technology goes on. But using this transit method, we'll never be able to get that 99.5% of geometries of solar systems that are just oriented the wrong way.

Ryan: Okay, I'm glad that you had something there, because I realised as I was asking the question that it was a really dumb question to ask, because if we knew a better way we'd be doing it right now.

Joanna: Yeah, and we can't change the orbits of the planets that are out there.

Ryan: Not yet…

Joanna: Um. Not yet, no. We might be able to beam a graviton beam or something, you know like, from the deflector dish, from Star Trek. But anyway...

Ryan: We could invert the Tachyon flow... Anyway, sorry - go on.

11:26 - The Radial Velocity Method

Joanna: Anyways, about the radial velocity method. That is a method actually that you can use to detect planets that are not necessarily going in front of the star. And what it involves, is it uses what's called the Doppler effect. It's basically detecting the velocity of the star away and towards us using the light from the star. You can see if it's.. if the wavelengths get longer or shorter and then you can measure the velocity. Now why would the star itself be moving away and towards us? Well that's a good question because normally we would expect the planet to be going away and towards us when it goes around the star. But actually the star itself wobbles slightly because the entire star-planet system goes around the centre of mass of the system and so the star ends up wobbling around the centre of mass. And so you can detect such a wobble using the Doppler method and using basic equations you can calculate at least the minimum mass of the planet using this method. So...

Ryan: Wouldn't that get super complicated once you have, maybe as soon as more than one planet? Like, three planets going around the sun at different speeds. The wobble back and forth wouldn't be as simple, you know: one metre to the left, one metre to the right sort of thing - because they'd all be pulling with different force.

Joanna: You can detect...

Rupinder: That's exactly right. That's exactly right, Ryan. So let's take our Sun for example. If we realise our Sun has eight significant bodies rotating around it as well as a bunch of other things. The sun does wobble as well, but that wobble isn't a very nice regular circular motion. It's much more like a spirograph. Do you remember that old toy when you were a kid and where you put a pencil in and you just sort of move around and it creates all these circular lines? That's essentially...

Ryan: I'm using one right now!

Rupinder: And so that's exactly the wobble we would expect from a star that would have many planets around it. And we do detect that and astronomers using gravitational equations are actually able to decipher that spirograph pattern into the fact that the star has: how many planets around it, what those masses are, and how far away they're orbiting the star.

Ryan: So it's a one to one thing? Either you never get a bunch of data that says, "Okay, there's either eight planets of this distance and mass, or 10 planets of this slightly different mass and distance?"

Rupinder: We can never be sure that we're detecting all of them. Because for example, Jupiter has a much greater pull on our Sun than Neptune does, for example. [Right] And so if you were a significant distance away from our Sun - yeah, probably you can detect the wobble due to Jupiter, but you won't be able necessarily to detect the Neptune wobble. And so, this technique has allowed us to discover solar systems with four planets around. If I'm not mistaken, that's about the max we've been able to figure out. Does that means there's not a fifth, sixth, seventh planet? No, it doesn't necessarily mean that. But this is another great example of that bias I talked about earlier. What kind of wobble are we going to detect with our technology? I mean, a technology we've only had now for fifteen, sixteen years. It's going to be the big, fat planets that are very very close to their stars. [Right.] They're the ones that are going to create the biggest wobble. We classify these planets - we call them Hot Jupiters. Which is a bit of a mystery itself, because we're used to tiny little planets being close to our Sun and really big fat planets being far away from our Sun, right. Like Mercury and Mars, Earth and Venus are tiny compared to Jupiter, Saturn, Neptune and Uranus. But what we've started to discover is a lot of planets that are Jupiter size or greater that actually live closer to their star than Venus or even Mercury, if you can believe it.

15:17 - Calculating mass

Joanna: I was just going to mention one of the disadvantages to the radial velocity method, is that we don't actually know at what angle the planet is orbiting the star with respect to Earth. So we don't know if it's right in front of it or if it's orbiting almost around the poles - like, I mean with respect to us - and so then you actually... That's why you can only calculate a minimum mass. You can't calculate its exact mass. Now when you combine that method with the transiting method - now the transiting ones, we know which angle their orbit is - they're passing in front of the star with respect to us - so then you can nail down its exact mass. And so often people will combine the two methods to nail down more of the properties of the planets that they're looking at.

Ryan: That's really cool. It's amazing you can do so much with this little information. Sorry, go on...

Rupinder: Except that we've left out one important parameter that it's also possible to detect. So let's say we can figure out the radius of these planets. We can figure out the mass of these planets. We can figure out the distance from the star and therefore the temperatures of these planets. We can also figure out density, right, because density is just a combination of mass and size - and therefore if we know the density then we know what they're made of. So we're like, "Wow! We know so much about these planets." But the last bit of information that is actually possible to get out of these techniques - and it's very very rare - is to figure out the atmosphere composition of the planets. And that's the goal. That's the real goal here. Because essentially, if we had a method... It's a pretty complicated sort of technique that I'm happy to explain, but essentially what we can do is realise what signature gases exist in that atmosphere by using a spectroscopy technique. And if those gases should align with what we consider Earth-like gases - nitrogen, ozone, oxygen, water vapour - these types of signatures - that would be very very alluring.

Ryan: And important, I agree. Because I looked it up while we were talking and you do actually take the atmosphere into consideration when you say "Class M." So if you want to go throwing around that label we need to know that nitrogen and oxygen appear.

17:30

Joanna: That's right. Now, one other thing to mention: perhaps in the news you might hear that Kepler has discovered, you know, 2,300 planet candidates. Now related to our discussion of methods, the reason why they're candidates is because the method that Kepler uses is the method of measuring a dimming of the star. Now a star can dim for plenty of other reasons besides a planet. It can dim because it grows and shrinks in size regularly. Or other reasons. Sunspots. So, they have to be confirmed to be planets - and the way they confirm them is using the radial velocity method.

Ryan: This is just an aside. Suns can grow and shrink in size regularly?

Joanna: Yeah. For example, they're actually called Cepheid Variables, and there are a few of them that you can see with your naked eye. I don't think you can tell the difference between their light. There are some that actually fade in and out of visibility, but ...

Ryan: Really? [Yeah.] What causes that?

Joanna: Different phases of the... Actually, like, certain phases, for example the red giant phase of a star is often quite variable. A star... in fact, and that's another reason why a star can brighten, is if it becomes a red giant, although that might be a little bit too gradual for us to see.

Ryan: Wow! That's fascinating. I didn't realise that we would see stars that sort of faded away like that. That's awesome. Space is crazy!

Rupinder: Yeah!

Joanna: Space is very crazy. The final frontier, right?

18:52 - Star Wars

Rupinder: Well, Ryan, since you brought up Star Trek, maybe I'll bring up the lesser of the stars: Star Wars, for a second. [Laughter] If you remember, at the start of Star Wars, where Luke is on Tatooine, and Tatooine has two stars, or two suns I should say. For the first time ever, scientists actually have discovered planets going around binary star systems. And this is a very surprising and interesting result. Essentially we assumed that the gravitational interaction of the two stars would create too unstable an environment for these planets to exist, but there has been a confirmed detection of a planet going around a binary star system. So, you know, Tatooine exists. [Laugh]

Joanna: Another aspect I wanted to mention about the two methods: I think it's pretty clear why is it that we tend to see the bigger ones - because they make the bigger wobble or they make the bigger black spot on the star like, meaning it dims more. But why is it that we tend to see planets that are really close to their stars? And if you think about it it's actually quite simple. The reason is because if they're closer to the star they'll have a shorter orbit. And we need to observe the planet for a few orbits before was can get a good, accurate measure of its properties. That's why we've only detected, up until Kepler, only, you know, planets that are close to the star. And so, Kepler's mission is to find earthlike planets, and so it's been staring at the same region of sky for a few years. And it's supposed to go on for three or four years. And so, by that time we'll be able to detect planets... if we wanted to detect Earth, for example, which has a one year orbit, you'd need to observe it for a good three years in order to nail down its properties, so Kepler should be able to detect planets like ours at around the same orbit.

20:41 - Citizen Scientists

Ryan: So this observation is that... when we're looking for the things Kepler's looking for - is it computational, like there's some gear that looks for these aberrations, or is it people going over, like, I guess, video footage or photographs?

Rupinder: That's actually a really good question, Ryan, and it brings in something that I do want to mention is a website called planethunters.org - so essentially what is done with these data that's coming from the satellite is they're run through computer systems, essentially, all of the rhythms that are designed to look for the telltale signs of planets. But it turns out that this data eventually is also available to everyone. Anyone in the world can look through - I think it's after about 18 months they've had the data - they allow anyone to look through it. And regular amateur astronomers - citizen scientists if you will - can actually discover a few of these planets now. They were able to find them in the gigabytes of data that this algorithm was not able to pick them out.

And so - it's actually really exciting, because astronomy has a very long history of amateur contribution. Amateur astronomers have made huge contributions, whether it was to do with pulsars - all kinds of stuff. And it's continuing today. You can be a planet hunter, working on the Kepler mission.

Ryan: This is crazy - that I could find a planet.

Joanna: I think about seventy have been discovered by amateurs.

Ben: If you find one, will it be named, like, Ryan-North-Three? Or will it be named, like, 700-B-H.

Joanna: Apparently they're giving credit to whoever discovers them, but they're going to acknowledge them in the paper they eventually publish, but I don't think they name them like that.

Ryan: This is sort of a side thing, but I've thought about it. When it comes to naming planets like this, obviously we all agree that Earth is called "Earth." Is there ever debate over what a planet should be called. If I discover a planet on this site and I decide it going to be called "Ryan-Is-Cool-Three" and no one likes that name, [laughter] for some reason. But have there been cases where, you know, someone publishes a paper and says "I found this planet. It's called Epsilon-Omichron-Three" and someone else says "No, no, no! It should be called, you know, HappyLand?"

Rupinder: I think the final word on the subject belongs to the IAU - the International Astronomical Union.

Ryan: So there's an authority?

Rupinder: There is an authority, and they meet every once in a while, and they decide what the official name of basically everything is, in space.

Ryan: How do I get involved in this organisation?

Rupinder: [Laughter] It's not impossible to become a member. iau.org - give that a shot.

Ryan: Is it impossible if you're not an astronomer to become a member?

Rupinder: [Laughter] You know what? To be honest, I haven't looked into this. They basically meet every three years for their tri-annual big meeting. By the way, these are the same people who demoted Pluto - what was it: about six years ago - from planet to essentially, we'd call it dwarf planet, or Kaipur belt object. And so yeah, it's hard to become a member.

Ryan: Really? I'll file that as plan B then. [Laughter]

23:44 - Naming planets

Joanna: I think most planets though are named - there's a convention that you're supposed to name it, you know, the name of the star and then B. Or you just put letters after every next planet you find around the same star. You just call it the star's name and then the letter.

Ryan: Is it letter in order of discovery or in order of orbit distance? Because then some planets might get renamed.

Joanna: You know, I'm not sure, actually.

Rupinder: I'm not 100% sure. Usually it's both. The way it's been - like, usually when we're making a discovery of a solar system of planets, you're basically deciphering the existence of all the planets at the same time. But there have been circumstances where there have been follow-up discoveries where they've discovered a fourth or a fifth planet and they've used the letters E and F. It's almost certain that you will discover a further away planet after a closer in planet. [Right.] And so, I think it's basically they're trying to do it from the star out, where the closest one would be B and the second one would be C and so on.

Ryan: So are the only planets with stuff that a person on the street would recognise as a name; are they limited to our solar system? These ones?

Rupinder: I think so. I can't think of anything else.

Joanna: Yeah. I don't know of any other planets with actual names.

Rupinder: There are names like "Blayees-443B" and "Perot/23B" and "HD65216C."

Ryan: They'll think we're a society of robots with those names.

Rupinder: Yeah, exactly! [Laughter]

Joanna: There are probably more planets in the sky that there are humans on the Earth so you'd run out of names eventually.

Ryan: Well then, you'd fall back to "Ryan-Is-Cool-Three." [Laughter]

Joanna: I see.

Ben: Statistically if you're naming things with just random letters and numbers eventually there'll be one called "Brian-Is-Cool."

Joanna: That's true!

Rupinder: You know what: They probably filter out vowels to avoid things like that, so you don't end up with the swear word planet by mistake. [Laughter.]

25:35 - Future Space Missions

Ben: So, do you want to talk about the future space missions?

Rupinder: Right now, there's two space missions that are ongoing and trying to discover planets and they both use this transit technique we've talked about. The one that we've talked about the most is Kepler. Kepler is a NASA mission. There's another one - CoRoT - which I've been told is a French mission by Joanna.

Joanna: CoRoT was launched a few years earlier than Kepler, so they weren't able to... they're able to detect planets that are just above Earth mass, and Kepler being launched later, they were able to increase their sensitivity, so they can detect Earthlike - Earth size - even slightly smaller.

Rupinder: The next class of missions that are going up, at least hopefully - you never know with budgets, etc. - is two called Gaia and Sim and both of these are actually interferometers. And everyone's seen an interferometer if you've watched that movie "Contact" you've seen pictures or video of the Very Large Array. The Very Large Array is a radio interferometer. It uses as series of radio telescopes to create a single picture. The point of this is to increase your resolution, seeing very very small objects. So what they want to do is put one of these interferometers into outer space to be able to detect much much smaller wobbles; to detect the change in velocity of a star due to the planets going around it to a much greater degree than anything you can do on the planet Earth - and that would be really fascinating because that is not limited to this 0.5% of solar systems where the planet goes in front of the star. And then finally, the last two ones which are no more than on the drawing board is the TPF - called the "Terrestrial Planet Finder" - as well as Darwin. And these are designed specifically to directly detect planets that are closer in size to the Earth. A lot of their work is theoretical right now, but if the money's there, if the scientific ingenuity is there, it won't be that long before we are at the point where we're not only discovering planets that are Earthlike and figuring out how hot they are, how large they are, how far away from their star they are, but also what their atmosphere is made of.

Ryan: This timeline, if everything goes well, this is like within my expected lifespan?

Rupinder: Absolutely! Absolutely! If the money's there, the technology is no more than two decades away.

Ryan: Sweet! I've got like, four or five left.

28:07

Rupinder: The real question is going to be - because this is one thing that is interesting, I think - if we're sitting here on the planet Earth, and we discover a planet similar to Earth that has atmospheric signatures like Earth, well one thing that we should know is that the atmosphere of Earth is the way it is because of the life on Earth. We and the plants and the animals have altered the atmosphere of the planet Earth to be what it is today. If we see these same life signatures in another planet, but that planet is a thousand light-years away, what do we do? What does that mean?

Joanna: How do we react to something like that?

Ryan: That's really cool.

28:49 - Closing words

Ben: Alright. Well that should sum it up. That was really interesting. I hardly had to say anything. So thank you, Jo and Rupinder. You have pleased me. Your efforts have borne fruit and that fruit is sweet. Here is some fruit. Rupinder, you get a banana, because it looks like the moon.

Rupinder: Um-num-num!

Ben: And Joanna, here is some star fruit for you. Way to go.

Joanna: Oh, why thank you. Mmmm! Wow! Nice star fruit.

Ben: I'd like to thank my guest, Ryan North - thank you for coming on the show.

Ryan: My pleasure. Thanks for talking to me.

Ben: That was really fun. Everybody, you can e-mail us at barn@titaniumphysics.com or you can follow us on twitter at @titaniumphysics. You can visit our website at www.titaniumphysics.com or look for us on Facebook. If you have a question you'd like my Titanium Physicists to address, e-mail your questions to tiphyter@titaniumphysics.com. If you are a physicist and would like to become one of my Titanium Physicists, e-mail physics@titaniumphysics.com. We're always recruiting. The Titanium Physicists podcast is a member of Brachiolope Media. If you've enjoyed this show, you might also enjoy "Science… Sort Of" or "The Weekly Weinersmith" so check them out. The intro music is by Ted Leo and the Pharmacists, and the end music is by John Vanderslice. Good day my friends, and remember to keep science in your hearts.

30:12 - Outro music

[Outro song; Angela by John Vanderslice]

Bonus Material / Cut scenes

30:58 - Class M?

Ryan: So would you - and I ask this in all seriousness - would both of you be comfortable to classify this planet as Class M?

Rupinder: I don't think so. I don't think so. If we're using the classical definition of Class M, I assume from Star Trek - is this where we're getting it?

Ryan: Yeah - unless there are actual international scientific classes.

Joanna: No, not at all.

Rupinder: I think the gravitational pull is way too high for one thing. There's no way that Picard would be able to handle the gravity. Data, yes, but that's different.

Ryan: Yeah - I hadn't even thought of that. That's true, right? There would be higher gravity because of the higher mass of the planet.

Rupinder: Yeah. And probably the atmosphere composition is going to be quite different as well.

Ryan: Well, I mean, this is just off the top of my head, but I'm not sure Class M specifies gravity. It might. I think it just means sort of Earthlike, and I guess that gravity does make it Earthlike. Again I should apologise for talking to actual scientists and I've brought it back to Star Trek.

Joanna: I'm not familiar with the actual definition of Class M, by Star Trek standards.

Ryan: Very few people are, because it's not practical knowledge. [Laughter]

Rupinder: And many astronomers get their start in Star Trek, so continue the line of questioning.

Joanna: Apparently there's a species on Star Trek that lives on lighter gravity, so they definitely wouldn't be able to live on this planet.

32:16 - Real astronomers

Ryan: So maybe I can flip this around and ask you both, as people who are actually, you know, real astronomers, real space people, whenever there's something that shows up like this that can be mapped on to Star Trek, or Star Wars or Firefly or some other science fiction spacey show: is it tiring to sort of get those calls from the media saying 'Hey, we want to have someone mention Star Wars for us now, please?" Does that happen a lot? Because I feel like it happens a lot.

Joanna: I'm actually a big fan of Star Trek, so I don't mind at all actually.

Ryan: We should talk.

Rupinder: Yeah. It's not... I'm not tired of it. I actually think it's a great way to bring people who don't have the science background into it. To help them understand how, you know, science works and relate it to something that they're familiar with. And so I'm teaching an astronomy class that's specifically designed for non-science students. This is business students and social science students and all this - nurses, a lot of nurses - and so, we talk in science for two of the three hours, but then for an hour of that class, or at least, like, a half hour of that class, I try to bring in a discussion that is a little more relatable. And so we'll talk about sometimes the business of space exploration, or we'll talk about your favourite science fiction show and what astronomy is real and what's not.

Ryan: That's cool. I studied computational linguistics in grad school, and our closest thing we had that was relatable was basically robots that talk to you and that usually lands on Lt. Commander Data, and that was frustrating because Data is this great example of a thinking machine who is created like a human, except in the linguistics part of that, he can't use contractions, and of all linguistics stuff that thing has to be the easiest problem to solve in the world. [Laughter.]

Joanna: Yeah, I always wondered about that.

Ryan: I mean, we can't figure out semantics, but contractions are dead easy. So it's frustrating because everyone's like "Oh yeah - computers talk, but they don't talk like people do." They can and can't.

Rupinder: Well, I'm still looking forward to the Blu-Ray "Star Trek: The Next Generation" regardless, coming out this month.

Ryan: Yeah, with high-def special effects. I'm totally proud this conversation is Star Trek. I'm sorry.

Rupinder: Yeah - Okay, back to astronomy. [Laughter.]