Astronomy Cast Episode 285 for Monday, December 17, 2012:
How the World Will Really End

Fraser: Hi, Everyone, it's Fraser here. So this is the second of the live shows that we've recorded during our "Not the End of the World" cruise in 2012. Once again, this was done in front of a live audience, so you'll hear them responding to us and laughing at our jokes (I hope) in the background. I apologize for the audio quality. We did this on a portable recording device. So this is going to correspond to episode 285 for December 17, 2012: "How the World Will Really End."

[begin live recording]

Fraser: Have you checked out the internet lately? Apparently, there's some kind of rogue planet causing poor alignment, and a killer solar flare that set off a chain reaction turning the whole universe into strange matter….after an alien invasion.

Pamela: All at once!

Fraser: All at once! This is all going to happen -- the internet told me! And the internet is always true. Everything you can believe, I found it on the internet. So today we're going to talk about...and especially this is really exciting because we're now on the eve of the apocalypse, the Mayan apocalypse as predicted by the Mayans...

Pamela: The world ends tomorrow!

Fraser: The world ends tomorrow, so actually, you know what, if you hear this recording right now, that means that the world didn't end.

Pamela: And we're good with that.

Fraser: Yeah, yeah, so you'll actually get this information, but you didn't need it because the world didn't end.

Pamela: So basically we're wasting our time right now potentially?

Fraser: That's exactly what we're doing.

Pamela: As long as we're clear on this.

Fraser: So what we're going to do is we're going to talk about a lot of the nonsense theories that we see posted on the internet predicting dire consequences of some kind of physics/astronomical nature that

sort of falls into Pamela's wheelhouse here, and we can sort of speak on it. And to be honest, we have been speaking on this stuff for years and years and years.

Pamela: It never ends. The Mayan apocalypse is only the latest apocalypse.

Fraser: Yeah, it's just the latest version of this constant string of people trying to freak people out.

Pamela: Or bilk them out of their money.

Fraser: Or bilk them out of their money, which is probably the best theory. So I think the one that is the most relevant right now is this idea of a rogue planet, a planet X or "Nibiru," as it were, which is...what it's going to do? This rogue planet is going to come out of some strange orbit, is going to pass near the Earth and cause some global catastrophe, polar alignment switching, and consciousness-raising?

Pamela: Yeah, I haven't heard the consciousness-raising, but we definitely need that part. The rest we can probably pass on.

Fraser: Yeah, right, and so it's like the size of Earth and...

Pamela: No.

Fraser: You cannot just say "no" to these things! Their evidence is strong!

Pamela: Their evidence is one lousy Sumerian painting!

Fraser: Right, so a long time ago, Sumerians, who really knew the future, predicted and drew their drawings...

Pamela: Who made really cool science fiction murals, carvings.

Fraser: They drew an extra planet in their carvings, in their sort of constellation, their aurorae?

Pamela: Or they just included the one they were standing on. That works too.

Fraser: So they predicted this extra planet, but then there's other research about possibly some sort of nemesis star that's orbiting the Sun, [missing audio]or whatever his name is, he's been predicting this sort of thing, so the evidence is really solid, and I have seen pictures on the internet, and videos on YouTube where you can see like there's the Sun, and like just below the Sun there's like this thing, like some bright little...

Pamela: Have you ever gotten dust on your lens?

Fraser: No, no, no! This is real! You've seen like this bright light on this picture, so that means that it's coming. And obviously you would think the astronomers would see it, but they don't because it's coming from a direction that no astronomers are looking.

Pamela: Have you heard of the Solar Dynamics Orbiter?

Fraser: This is the rogue planet theory. Feel free to debunk it.

Pamela: OK, so the whole problem with this "rogue planet" theory, this rogue planet that's like theoretically the size of the Earth. If you go outside with cool binoculars, which several of you in the room have with you, you're going to see the moons of Jupiter, which are way, way smaller than the planet Earth. Some of the ones you're going to see – they're smaller than the Moon, and yet, the idea is that even though we can see these moons of Jupiter that are, well, if you were travelling through the Solar System, they're several years' travel time way, and yet the theory is that there's an Earth-sized object that isn't naked-eye brightness that is going to clobber us tomorrow. Now, there's multiple problems with this theory. You go outside, you see the Moon, the Moon covers a section of the sky, the Moon is lit up by the Sun. If there is an earth-sized object about to clobber the planet Earth, first of all, we would have seen it years ago unless it's made of some special non-reflective material, in which case we would have seen the lack of...

Fraser: It's made of dark matter.

Pamela: Shhhh! OK.

Fraser: I'm not helping, am I?

Pamela: OK, so dark matter doesn't cluster that way.

Fraser: I'm going to start a whole set of doomsday myths.

Pamela: Let's say we had an Earth-sized planet under normal Earth-like conditions on its way here. It would have been extremely bright three years ago, naked-eye brightness depending on its orbit. It definitely would be naked-eye taking up a huge part of the sky right now if it was going to hit us tomorrow, and it probably would have moved the Moon. Now, the nice thing about going out right now is we have a nice going-towards-quarter Moon that is setting right after sunset, setting more and more after sunset, and so if you go outside, you can see the Moon behaving as it should, setting 45 minutes later, every night at a friendly time for people who want to go to bed and not see dawn, and in the process of seeing the Moon, we haven't seen it deviate from its normal orbit, we haven't seen a giant, bright object blocking a large part of the sky, and even if this was an object of unusually non-reflective characteristics, it would be blotting a large section of the sky in a very non-cloudlike way, and since we've neither seen stars winking out as this planet heads towards us, and we have not seen gravitational distortions of objects that it passed, and orbits that it affected, and we have not seen

bright object coming toward us, there is not a planet that is going to hit us tomorrow. And if someone tries to say, "No, no, no! We just got the dates wrong," which is one of those things that you hear after each of these the-world-failed-to-end moments. If you hear tomorrow, "Oh, no, no, no! We just got the calculations wrong. It's actually happening next year. We forgot the year zero. The Mayans didn't have a zero." When you hear that excuse, you should still either not see a section of stars, or see a bright, highly reflective place, and you should definitely see planets not going where they're supposed to due to their gravitational interactions with this object that does not exist.

Fraser: OK, OK, OK. You've...I'm not quite as scared about that, but I am pretty scared about this solar flare because I've heard that the Sun is at its active solar maximum stage that's happening right now, and it's particularly active and there's going to be a gigantic solar flare that's going to blast off the Sun and it's going to roast the Earth.

Pamela: Are you planning to spend time in the International Space Station in the near future?

Fraser: Yeah. But, no.

Pamela: Really?

Fraser: No, no, no. Had I been invited, yes, but I have not been invited, but I'm waiting by the phone.

Pamela: Are you a telecommunications satellite?

Fraser: Where are you going with this?

Pamela: Are you reliant upon electricity in order to stay alive?

Fraser: Yes. Would I lose the internet that's teaching me all of this stuff?

Pamela: So the thing is we do watch stars like the Sun on a regular basis trying desperately to understand what are the possible things our Sun might do if it misbehaves. And we've been living with our star for, well, as a planet for several billion years, and we've seen it misbehave in various ways – none of them Earth-destroying. And as we watch star after star after star that is similar in chemical composition, similar in mass, similar in every aspect that we can to the planet Earth, and we study these stars as close as we can in hopes of finding planets going around them that we can detect through either transit or Doppler shift methods. As we studied these stars over and over and over looking for extra-solar planets, we do not see planet-destroying misbehaving. Now, what we do have to worry about legitimately during solar maxima is solar flares that shake up the Earth's magnetic field and in the process trigger extra electricity to flow through the power grid and knock out the power grid. This has happened before. This happened, in fact, in your country when Quebec lost its power grid. We have to worry about the occasional communication satellite losing its life in the name of solar flares, and astronauts in the International Space Station may need to worry, but in general, no, they're fine. This is

something that we as human beings on the planet Earth, as long as we have back-up batteries for all medical devices, we're good.

Fraser: So the Sun is capable of producing very large solar flares that are damaging to [missing audio] and produce very beautiful aurora, but nothing that would wipe out the planet.

Pamela: No, no. Might wipe out power grids, but that's all we have to worry about.

Fraser: I'm not so afraid. Now, I have also heard that all of the planets are going to be lining up in one long line in the sky above the pyramids actually -- quite exciting! Have you not seen this? There's going to be like the three pyramids of Giza and there's going to be, I don't know Mercury on top of one and Venus on top of another....right, but when you get that, then you get these powerful gravitational effects from all of these planets...

Pamela: No. No.

Fraser: You'd better hear me out. This stuff is really compelling! The powerful gravitational effects of all these planets, I don't know, shooting out space laser beams at us or something from space. I'm making that part up, I think. Right, but powerful gravity...

Pamela: So Jupiter [missing audio]...

Fraser: Right...but planets do align?

Pamela: Well, of course planets line up. We call it opposition, we call it conjunction, we have many words for it. The truth is the planets in our solar system more or less all live in a disc, they have the ability to all line up every once in a while. This last happened the prettiest back in 1999, and while, yes, there is a slightly great gravitational pull when all the outer planets...

Fraser: Whoa! Slightly? What?

Pamela: But a semi-truck driving past you has more of a gravitational pull on you than all of those planets. Now are you worried about the gravitational interactions between you and a semi-truck?

Fraser: No. No.

Pamela: No, you're good. You're good. It makes pretty pictures.

Fraser: Right, but then you experience really tiny amounts of gravity from those objects. It's just that the Sun is really powerful...

Pamela: And we're standing on top of the Earth. In our day-to-day lives, the Earth's gravity is the dominant factor. The secondary factor that we deal with is the Moon. It triggers tides; it actually raises the peaks of mountains up and down with its gravitational force. The Sun is the next largest effect, also helping with the tides, secondary to the Moon. We don't get a high tide because of the Sun, we get higher tides sometimes with the Sun, but at the end of the day, the planets are far away. They're just not that big an effect on our day-to-day lives, that semi-truck driving past you – much more detectable. In fact, one of the neatest bits of science I ever learned was in Washington state they have lots of mountains, and there's a gravitational physics lab, I believe in Seattle, that they have to correct for how rainfall soaking into nearby mountains changes the gravitational pull from those mountains on the highly sensitive equipment in their lab, so rainfall soaking into a nearby mountain -- more of an effect than those nearby planets.

Fraser: Yeah, in know, I'm already very familiar with rain. OK, so fun! But I've also heard that the Sun is going to pass through the center of the galaxy, or something.

Pamela: That would be very difficult to do.

Fraser: ...and the Earth, and the galaxy, no...they're going to line up in the sky. You're going to get the center of the Milky Way, you're going to get the Earth, and you're going to get the Sun, and it's all going to be lined up, and again, laser beam, gravitational cosmic awareness is going to happen, right?

Pamela: No. So again, think back to 1999, we had everything nicely aligned, lots of panic in the occasional newspaper, nothing happened. The reality is the Earth, the Sun, and the center of our galaxy roughly align every year because the center of our galaxy is in the constellation Sagittarius, so when the sun is in Sagittarius, which happens in December (those of you who happen to be December babies probably know this), when the Sun is in Sagittarius, at one point, it is more or less lined up with the center of our galaxy as seen from the planet Earth, and really, it doesn't have any effect other than you can't observe Sagittarius when the Sun is in it, which is annoying.

Fraser: But it's going to be happening tomorrow, they say, but it actually happened like 20 years ago.

Pamela: Yeah, at its most aligned.

Fraser: Now, OK, so here's the one, and I think I saw this on Nova, right, and so I think it's pretty legit, and this is the idea that the magnetic field on the Earth has flipped in the past, doesn't very often and we're overdue for this geomagnetic reversal, and when this happens, then we'll all fly up into space.

Pamela: Yeah, we're not going to fly up into space, but there's an issue of time scales because while really bad things will be really bad if they happen quickly. Sometimes it's the opposite of removing a Band-aid: when it happens slowly, it's better. And when our Earth's magnetic field flips, yeah, that's kind of a bad thing because the magnetic field of the Earth is what protects us from damaging cosmic rays, and a lot of other bad stuff we don't want to experience. This is why going to Mars is a bad thing.

It doesn't have that magnetic field. Well, the Earth's magnetic field does now and then decide to flip polarities, and there is a period in which there isn't significant magnetic field. There's no mass extinctions tied to this, however. There is clearly going to be bad things that occur: higher cancer rates, higher...but it's going to happen slowly and we now have the ability to do things like build caves and go underground where we're protected from things...

Fraser: Are we going to have to go underground?

Pamela: We will be the mole people!

Fraser: Wait a minute. OK, so this sounds like it's really going to happen, but the point being the worst that's going to happen is increased rate of skin cancer, and it will take a long time.

Pamela: It's a slow and gradual process. So we're looking at something that happens on the scale of 1000s of years, and so it's not like we're going to wake up one day and suddenly we no longer have compasses working on our iPhones or Androids because, really, who uses a real compass anymore? You leave them in a box of magnets, they die. The iPhone lasts better...but this isn't something that we have to worry about.

Fraser: But what we do have to worry about, I've heard from a time traveler who has come back from the future, has posted that (now we're a little late for this, so it didn't happen), so the Large Hadron Collider, which was constructed in Europe, when turned on for the first time would create a black hole that would destroy (I know it already happened, but you know let's pretend this didn't happen for teaching purposes for learning)...

Pamela: They will be cranking it up to higher energy levels.

Fraser: Oh, there we go. So they're going to be cranking up the large...so right now it's perfectly safe, but yeah, so the idea is that the Large Hadron Collider is going to be creating miniature black holes and could be dropping these miniature black holes into the Earth.

Pamela: Go, black holes!

Fraser: So is this possible?

Pamela: Totally possible! Totally awesome! I want this to happen!

Fraser: Wow! OK. Well, then there must be some kind of scientific reason why I should not be freaking out right now.

Pamela: No, a microscopic black hole...so if Stephen Hawking is correct, then the microscopic black hole gets formed, and then as close to instantaneously as something can happen while still taking time, the

sucker's going to evaporate, release a large burst of energy, we give him the Nobel prize, we move on with life.

Fraser: But how long should this take?

Pamela: Fractions of a second.

Fraser: Right, so if these microscopic black holes are created...

Pamela: And Hawking is right...

Fraser: And Hawking is right, then they will...OK, so if they're created and Hawking is wrong, then we have brought black holes into the Earth.

Pamela: Which is awesome!

Fraser: OK, OK...

Pamela: What do you have against black holes in the center of the planet?

Fraser: I don't know they could be gobbling up the inside of the planet and us kind of crumbling inward in a hollow shell.

Pamela: But the awesome thing about microscopic black holes is they're microscopic! In fact, they're so tiny they pass between atoms just kind of happily going to the gravitational center of the planet, attracted just like we are, except we luckily don't pass through the floor. If I were to make a black hole and drop it right now, it would pass through the floor, through the bottom of the ship, through the ocean, through the mantle of the planet, happily going through all the stuff until it found that nice, happy place where its gravitational potential energy equaled zero, and it would sit there, so tiny that the probability that it could eat something, could gnaw on atoms around it was such that it might eat something every few decades, every few hundred years and it would grow so slowly our planet would be destroyed via other means before it gets measurably large.

Fraser: OK. Alright.

Pamela: We're good. I want black holes.

Fraser: OK, I'm going to put that on the slightly concerned list. Now, but also, I mean, really the Large Hadron Collider could kill us in a bunch ways. The other way that I've head is that it's going to instantaneously release some kind of energy cascade of frozen, strange matter at the speed of light, converting the Earth and eventually the entire Universe into this strange matter, and killing us all in the process.

Pamela: So this is a common concern, but the Large Hadron Collider is not what we need to worry about.

Fraser: What?!

Pamela: So here's the thing. There's always been that rogue, not rogue, that mainstream theorist working on numerous ideas, not all of which are true, which include things like they were worried when the Apollo missions landed on the Moon that the Moon had such thick dust that they would just sink down into the dust – dead astronauts. That was a semi-legitimate concern. There have been concerns that when we turned on the linear accelerator at, I believe, Brookhaven National Lab that that would cause the type of nuclear reactions that would destroy the world -- didn't happen. There's always that theory or two, that nowadays lead to legal cases actually, that when they turn on these facilities it will destroy the Universe. We're just one planet in a vast universe, where I'm sure there's a more advanced civilization that has already gone through all of these steps.

Fraser: Or we're alone.

Pamela: Or we're alone, but I'm going to go with there's some other civilization out there that's tried all of this, and they may have blown themselves up, but they didn't blow up the Universe.

Fraser: Or we're the strange matter, right?

Pamela: That would explain so much.

Fraser: So we're the result of a failed alien experiment. Right.

Pamela: But the reality is that our Universe could decide spontaneously to collapse to a different energy level, it could spontaneously merge with another universe, but these are beyond our control. We're not affecting the Universe as a whole; we're simply colliding atoms together.

Fraser: So we can't kick one of these off. From what I understand, you take some of the particles, some of the rays coming from...created by supermassive black holes, they're producing much more energy than our Large Hadron Collider.

Pamela: The Universe is already running these experiments. We call them AGN. It's fine. We're fine.

Fraser: Right. AGN?

Pamela: Active Galactic Nuclei...quasars.

Fraser: Right, supermassive black holes spewing out energy particles.

Pamela: The accretion disk's magnetic field surrounding the supermassive black hole...black holes don't spit things out.

Fraser: Right, they suck them -- like the inside of the Earth.

Pamela: [laughing] Again, I'm good with that.

Fraser: OK. Well then, the last thing, then, is and I guess this is kind of related to the rogue planet idea, that we're going to be hit by a comet or asteroid.

Pamela: So this is actually the one that could happen, but if someone knew about it, we'd probably all know about it, so you hear occasionally about there's this government conspiracy theory and Apophis is really going to destroy the Earth. Apophis is an asteroid that is going to come very close to destroying the Earth, but not actually do it according to all current data. We are watching it closely. Now the thing is anyone with a backyard telescope has the ability to go out and make the measurements necessary to figure out if we're going to die. There would be international herds of amateur astronomers trying to figure this out if it looked like it was a high risk. So many people can see these things. You can't keep it secret, and even if you tried and this was only accessible to professional observers, we astronomers are in general not to be trusted with secret information. I remember as a baby astronomer (and I'm not going to say where I was at the time; I worked many places as a baby astronomer), I was working happily away on my data, and in flies my advisor and says, "This is so cool and I'm not allowed to tell you, so you can't tell anyone!" And I'm thinking, I'm not even of drinking age, and so these things happen and we aren't to be trusted with secrets and so anyone who tries to think of scientists more than one are involved in a conspiracy theory doesn't know scientists.

Fraser: Yeah, it's the journalists who are to be trusted with secrets. Right, OK, so I think...so here's the last one, and I think this is a good one. This is the one that really scares me, and this is the possibility that we are under threat of alien invasion, right?

Pamela: Again, we'd see them ahead of time probably.

Fraser: But no, they're all among us. They're all around us. The invasion's already begun. OK, so obviously there's no way to know for sure if the aliens are among us and they look just like us, which is ridiculous.

Pamela: Battlestar Galactica 1984! 1980, sorry...1980.

Fraser: Let's imagine there is some kind of alien fleet on its way to us. Would we get any kind of advance notice?

Pamela: See them, unless they were coming...the only way we wouldn't see them ahead of time -- because it's going to take vast amounts of energy to have an invasion force headed our way -- the only way we could potentially see them is if they have a course such that as the Sun, so the Earth is orbiting the Sun and they are coming in just so that they always stay directly behind the Sun, or in a line with the Sun somehow, managing not to be observed by a Solar Dynamics Orbiter, by the mission and it has an A and B on either side, I just lost it...[missing audio] Stereo...so that it manages to avoid being seen by Stereo A or B, which right now is really hard because they can pretty much see behind the Sun. There's really no way that an alien force could get to Earth without being observed if they're big enough to actually invade our planet. Now, things we do need to worry about...and this is where you and I know Scott Sigler. If you ever want to terrify yourself and cause really weird nightmares, read his books. One of his books includes the idea of an alien probe coming in and scattering a biological that is meant to open a gateway and all sorts of scary stuff. Go read it. Terrify yourself. We don't need to worry about the invasion fleet. We need to worry about the little, tiny equivalent of a Voyager II that comes through our atmosphere and releases toxic bacteria, but the invasion fleet – not a concern.

Fraser: Right, so any spaceship, or group of spaceships capable of getting here from some other location...

Pamela: Independence Day is not going to happen; Falling Sky is not going to happen. Someone needs to interrogate Kevin Grazier about how he thinks that the Falling Sky fleet got to Earth without being detected.

Fraser: He's here. Get him! Great...OK, so I think I am suitably pacified now. I don't think I'm quite as nervous about all of these things, but I think the point here is all of the...I'm going to border on calling them scams, you know. People are freaking people out on the internet, you see them on these forums they try to go to as many places as they can and get the word out...

Pamela: And they're trying to sell books, they're trying to sell survival gear...they're making money off of fear.

Fraser: If someone's trying to scare you, you've got to figure out why they're doing it, and if there's any scientific validity to what it is they're talking about. And in many cases, I've gotta say that the [missing audio] astronomers have got to be trusted on these matters.

Pamela: And we can't keep secrets.

Fraser: Well, thank you very much, Pamela. I appreciate that.

Pamela: My pleasure.

Fraser: Alright!

[applause]