Western Science

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EPISODE TITLE

The Next Hubble: The James Webb Space Telescope

PODCAST SUMMARY

One year in advance of the James Webb Space Telescope's official launch, Western Science Speaks is thrilled to be joined by Prof. Els Peeters, for an all-you-need-to-know audio exhibit of the revolutionary telescope that will follow in Hubble's footsteps.

INTERVIEW

You're listening to the Western science speaks podcast. Presented by Henry Standage.

Henry Standage 0:30
Few disciplines take as forward thinking as vision and commitment to patience than making advancements in the frontier of studying space. The launch for the James Webb Space Telescope was developed back in 1996, and it was conceived as a successor to the iconic Hubble Space Telescope. 14 years later, and the James Webb is on the cusp of its official launch. Els Peeters, a professor at Western Physics and Astronomy Department has been helping construct Canada's plans for the telescope. For the past decade, she came onto the show to explain what makes the James Webb special and what Team Canada hopes to find once it launches. Here we go.

Henry Standage 1:10
We talked about the James Webb Space Telescope in the summer for a little bit. Why don't you just tell us what it is? What's its contribution to Canada, and what you've been up to with it since the summer?

Els Peeters 1:22
So, the James Webb Space Telescope is the next big space mission. It's the successor of the Hubble Space Telescope, which most of you may know from the pretty pictures that he has that took. And so James Webb is a $10 billion mission which is organized or developed by NASA and the Canadian Space Agency. And so, Canada's contribution to James Webb would be the Fine Guidance Sensor. And one of the four instruments, the near infrared imager limitless spectrograph.

Henry Standage 2:01
Because people might not know exactly what that means, what do those things add when you're trying to use a telescope.

Els Peeters 2:08
So, the Fine Guidance Sensor will be used to know the position of the telescope to know your target position and to keep the telescope fixed on the target. So you can take your observations in the best circumstances, and the near infrared imagery and spectrograph is basically one of the four science instruments on James Webb and so it can give you either images or spectra, which is basically where you see the brightness in function of color in the near infrared. So, the shorter wavelengths, the hotter colors.

Henry Standage 2:49

How are Canadians involved in the entire process of this from the actual science to the building of the telescope, to how it's used practically in the future?

Els Peeters 2:59
So, Canadians got involved in building tasks by contributing these two hardware components. That means because they contribute these hardware components and also the corresponding software that is needed to analyze the data. It means the team that built instruments, they guarantee the instrument team time on the telescope. So, there will be two large guaranteed time proposals from the Canadian instrument team. One will study the atmospheres of planets, and the other one will do a survey of galaxy clusters. And so that's one way of getting involved. But also, by contributing, we can guarantee a minimum amount of time on the telescope. So, any Canadian researcher can propose in the channel observer cycles.

Henry Standage 3:58
So, if Canada didn't contribute any hardware they might not be allowed to use this telescope.

Els Peeters 4:04
That's not entirely how it works. So, this is an international telescope built by three agencies. And so, for those agencies because of their contribution of hardware, there's a minimum set of time that you get. But the James Webb Space Telescope, any astronomer from any place in the world can ask for time, it just that because if you contribute hardware you get guaranteed the minimum amount of time.

Henry Standage 4:30
I see. I see. It's a good incentive.

Els Peeters 4:32
Yes, well, and it's also it helps you getting involved in the program from the beginning. So, you can also guide a little bit of very technical requirements. And then you also get involved from getting expertise that you otherwise would not get and because the instrument team is here in Canada, they can talk to the other Canadian astronomers and basically help them meet for example, writing their proposals and how to use the tools and certainly how to use their instruments. And so that's very good knowledge to have, if you are writing proposals.

Henry Standage 5:09
Why don't you tell us a little bit about why you're interested in studying molecules through this telescope.

Els Peeters 5:15
So, my research is focused on large carbon molecules. And so, when I'm talking about large, we're talking about somewhere larger than 20 carbon atoms up to let's say, 150 carbon atoms, we detect these molecules. So, what will happen with these molecules there's almost everywhere in space. And so, they see the radiation from nearby stars for examples, renewable resources, that can absorb some of that radiation. When they absorb that radiation, they get very, very hot. And so they cool down after such an absorption of this radiation, this energy they cool down again by emitting energy in the infrared. So how they do it is basically start vibrating.

Henry Standage 5:59
Is that how we detect them?

Els Peeters 6:00
That's how we detect them. So, in the infrared, we see very specific radiation from these molecules to these vibrations. And so, the James Webb Space Telescope, which the sensory is basically in the infrared.

Henry Standage 6:17
Then it allows us to see kind of how they interact or engage with one another.

Els Peeters 6:21
It's not necessarily they're not really engaging with one another. It's real, it's more what we're interested in is how the molecule will change. If the radiation changes, if the density changes, if the conditions of your environment changes. How do you get the same molecules? I mean, no, that's not the case. That will change but we don't know exactly how they change. And so, with James Webb, what we get is we get a very high spatial resolution. What it means is that you know, if you look at a star, when you have a massive cloud, it will collapse, and it will form a star. Once if you form a massive star. What will happen if the star gets born? It starts to emit radiation. Okay, that radiation will disrupt the cloud out of which is born, it will basically heat the gas and the gas will ionize atoms molecules, it will change the molecules. And so, James Webb allows us now, we can basically probe the molecules on a physical scale on which that these changes have. If you have a massive star, close to the star, it's hot for the way to get colder and colder same with the fireplace. In the old days with previous instruments if you would take a spectrum you would observe the light from these molecules, you would get it on a region where you have a large temperature range. Now with James Webb this bit spatial resolution is much sharper. So now you can see it on a much smaller temperature range. And that range is similar to the range at which changes to the molecules occur, because of the radiation.

Henry Standage 8:01
Yeah, that was really well explained. And are you teaching a program about the telescope?

Els Peeters 8:08
Last term I was teaching the interstellar medium course for our astronomy students and also some physics students. And so, these molecules are part of the interstellar medium, which is stuck between the stars. And so, it's in our own Milky Way, but also in other galaxies. In between the stars, you will basically have the smaller perspective.

Henry Standage 8:31
How long has it been built for? Are we talking like 10 years?

Els Peeters 8:35
These telescopes take 20 to 30 years for sure.

Henry Standage 8:41
Okay, so how long has it been on your radar?

Els Peeters 8:44
So, I'm not involved in building the hardware. So, we started thinking about programs to propose for the James Webb. Let's say we start getting organized in in 2016. Then. So what happened is there, James Webb has this very special program, which is called the early release science program, it was very attractive to scientists because it, if you get a program in that category, it means that your data will be observed in the first three months, three to five months from James Webb when it was operational. And so, since it's a new telescope with completely new instruments, which are orders of magnitude better than what the previous instruments were, every detection will give you new discoveries, because it's, you're dealing with uncharted territories. And so, in that sense, you know, everybody wants the first data. And so, this program was particularly made so that you have to show what James Webb could do. And then the data would be immediately taken, once James Webb is operational. So, we with our community, we were very eager to get data on this telescope, because it's ideally suited for the research that we do. So, we are going to organize and we basically proposed for that within the category and we got time.

Henry Standage 10:08
I imagine it's a bloodbath to get time in the first year.

Els Peeters 10:12
Yeah, so this was only for the early science program. So, this was a special category so basically the cycles of telescopes is cut in pieces of years. And so, the first cycle as you say, the first year is called cycle one. So, one call for proposals will only come out the end of this month. And then people can write proposals and then it will be decided somewhere in the fall, who gets time. But this category that the early release one was called was tactic time for the early science program. The time was taken from the directors' discretionary time. So, the director of the telescope has a few hundred-man hours available to him every cycle that he can basically give two astronomers, if they make a good case for it. And so, he decided for the first cycle that the majority of his time was given to his early release science program. Because then the date of his early science program will be public immediately to the entire sun, local community, and everybody could see what James Webb could do, and then start thinking what James Webb could do for their science.

Henry Standage 11:25
Where's this telescope located?

Els Peeters 11:28
So, I think currently it is in California, okay. And so, it's in Northrum. And so, it will be completely assembled right now and it's getting tested. And so, it will be shipped to French Guiana at the end of this year, hopefully.

Henry Standage 11:52
And then you'll travel down I guess to use it.

Els Peeters 11:55
No, actually you don't travel down, so it will be launched from the Ariel rockets charter launch. And so, then it will take six months before the mirrors folded, so you have to unfold the mirror because the mirror is six and a half meters, it doesn't fit in the rocket. And so, you have to unfold the mirror and test all the instruments. So that will take six months. And only after six months after launch, the science data will be taken. So, you don't have to travel anywhere to get science data. Okay, this is basically all via computer you have to say what type of observations you want to do, and you have to specify every technical aspect. And then people will in space telescope in Baltimore, they'll basically process it and send that information to this telescope, say like, okay, now you have to do this type of observations. So, no travel involved.

Henry Standage 12:52
I guess that's modern telescopes. I just imagine you guys looking around through the glass.

Els Peeters 12:56
That's with ground-based telescope. Yeah. So, for ground-based scopes, especially in the old days, you could. I traveled to Hawaii, traveled to Chile because we had to go to the telescopes and that's where the weather was best. And so that's where the telescopes are. But nowadays, even for ground-based telescope, it's much more efficient if they can say like, okay, we have two programs one requires excellent weather. The other one requires medium type weather and can be done even with bad weather. And so what they do now is they do Q-observing which means it's like they look at the weather, if it's excellent, they do these programs that need excellent whether it's, you know, less medium type, whether they do these programs and require medium type weather. And so that means you observe it doesn't get to travel anymore there because you can never predict when your observations will be taken. So, all the big telescopes except the Subaru telescope, actually you do not

get to travel there anymore unless your observations require you to seek that telescope at the time of the observations, which are very few observations.

Henry Standage 14:04
I never knew there were so many politics with telescopes.

Els Peeters 14:08
Yes, yeah, there is a whole kind of policy of how things, you know, happen. But it's a problem now, because you would hope that an astronomer if you train students that they get experience at the telescope. Well, yeah. And so now because everything goes by, you know, setting everything on a computer, the technical details, and then you send it off to the people who operate the telescope, they don't get to experience it anymore. So if you want students to get experience on telescopes, you basically have to apply for small telescopes, where you can still send people there to actually do the observing,

Henry Standage 14:43
Maybe we should propose that western builds its own telescope.

Els Peeters 14:47
Western has some telescopes. We have two telescopes on campus. Then you have another telescope, which is on top of the Western science building. Okay, so we've got three and then we have one which is also no longer used, it's called the commission but that that land is being used for observations of meteors and also my colleague, Stan Metchev, he's building a new small telescopes to observe Kuiper Belt Objects.

Henry Standage 15:28
Okay, well, it sounds like Western has got it stuff handled.

Henry Standage 15:33
That wraps up another episode of Western science speaks. You can find out more about the James Webb Space Telescope on the NASA website and keep an eye out for Dr. Els Peeters research over the next 18 months. You can subscribe to Western science speaks on Apple Music and Spotify. And we also air on radio Western Mondays at 11:30 am. I'm Henry Standage, signing out. Thanks For listening