[MUSIC PLAYING]

KAREN FOLEY: Hello and welcome back. Well, we've had a little brief lineup in terms of the programme today. You've seen who our guests are who we'll be talking to and we've had a little bit of interactivity. It's great to see that we've got some people from Africa. Welcome to the Student Hub Live.

People are eating their lunch right now. Devon says it's surprisingly sunny in Wales. I'm very jealous I'm not there right now, actually, because it's quite cold here. Simon's eating a pizza and has offered to share a banana with HJ, I believe. So how is everybody out there?

HJ: I think we're all good and happy and some people, as we said, are very lucky that it's sunny by them. But a bit cloudy around here, didn't we say?

SOPHIE: We did forget to mention our posters earlier, as well.

HJ: Yes.

SOPHIE: So we do want people sending in their selfies, all sorts of pictures, your study buddy, your study spaces, and particularly today, pictures of their best cloud. We do have some poster prizes so we've got-- that Rhian actually very nicely made. So we've got this one here. You see Mars Weather Forecast poster here. And we've got another one you can do.

HJ: This is all about the lander, as well. So these are really cool. Yeah, maybe I can send one in and get one.

SOPHIE: So send your selfies, cloud pictures, all sorts, and then hopefully, we can send those out to a few of you. That'll be great.

KAREN FOLEY: Lovely. So we've got a limited edition of these special posters that have been made. Send us either your best cloud-- I don't believe even if it's sunny that there isn't a cloud potential out there. So send us a picture of your best cloud-- studenthub@open.ac.uk or #StudentHubLive2016.

Those will be coming into the studio in real time so do get us your pictures. And then if we select from the first number of people who've entered, we will send you out one of the posters and possibly maybe even get Rhian to autograph some of them for you if you'd like. So we will

send those to you as a memento of this event.

All right. People are also talking a lot about drilling on Mars, which brings me back to the discussion at hand. So Jon, thank you for coming to talk to us today. Now, your session is focusing on this Trace Gas Orbiter, which is arguably one of the most important aspects in terms of the ExoMars mission. But you're a scientist working on ultraviolet and visible spectrometer-- so one of the spectrometers that's in the Trace Gas Orbiter. Could you briefly explain to us what all of this is and which bits you're involved with?

JON MASON: So this is the Trace Gas Orbiter and you've got the Schiaparelli Lander on the top, which is now separated. And it is an orbiter of two countries. You've got the European side and the Russian side. So first of all, you've got the Russian side, which is the ACS, which is a spectrometer like the one I work on except it's complementary. And then you've got the FREND, which is a mutron detector.

The European side has the stereo camera called CaSSIS and it's capable of producing HD stereo images of Mars. So you'll be able to get 3D images of the surface. And the bit close to my heart is NOMAD, which is this box at the top. And inside there are three spectrometers, two infrared spectrometers and one ultraviolet invisible, and it's the ultraviolet invisible that I have been involved in and I have developed. And it is just this little part here of this whole NOMAD section.

KAREN FOLEY: How does it feel saying "just this little part here" of this when we're obviously talking about something that's absolutely-- well, clearly a lot bigger than this and is orbiting Mars right at the moment.

JON MASON: So I say "little." It would fit in the palm of your hand. And then size doesn't matter when it comes to space because everything is miniaturised down. So even if it may be small, it's also got a huge scientific impact. It produces about 80% of the data on TGO when we did some commissioning tests. So it's a very powerful spectrometer and it will be the most powerful spectrometer that's been sent to Mars to date.

KAREN FOLEY: You must feel so proud of that involvement in something like this. It must just feel amazing saying, I'm involved in that and here's what's happening. And it's so current right now.

JON MASON: Yes, it's fantastic. I count myself lucky to actually be involved in this mission. It's certainly what I've always wanted to do and to be able to pursue that as a job is certainly just fantastic for

me.

KAREN FOLEY: That's phenomenal, isn't it? And we've got some widgets and we'll come back to the widget in terms of how everyone's feeling right now. But Jon selected some widgets for this session which will be appearing on your screens. So there are some options there to tell us what you think.

"Which would you class as the most dangerous part of the Trace Gas Orbiter journey?" So there's a range of options there. And then there's a question about GPS in space. So in order to plan our observations, we need to know accurately how to position the Trace Gas Orbiter. So how accurate do we know the position is? 1,000,000 kilometres away-- is that right?

JON MASON: 100 million kilometers away.

KAREN FOLEY: 100 million-- I think we had a zero issue there at some point. OK. And then life on Mars-- do you currently believe that life exists on Mars? So let us know your thoughts for those. You just select the options that apply to you in the widgets, vote for what you want to do, and then close those back down. And you'll also be able to see what everyone else has been voting for, as well, and we'll feed those into the conversation.

And Jon, it's really nice of you to come because I know you've been poorly and you've had these colds that we've all had. So do have a drink and things as we go through.

I wanted to talk about the separate mission phases first because obviously, there's this journey to Mars and then there's the Mars orbit insertion, which has been really successful. Then there's the aerobraking and then the science phase, which is where we're at now. Can you talk us briefly through those various phases and just a little bit about some of the challenges at each point?

JON MASON: Yeah. So the first stage obviously is a launch. You've got to actually get the orbiter into space and that carries a huge risk. That happened on the 14th of March this year and it was successful. We managed to get it into the Mars transorbit. And the Mars transorbit takes about seven months. So we travel to Mars seven months where we do do some tests but the spacecraft travels quite quietly to Mars.

And then this week, we've had the critical manoeuvre, which is the Mars orbit insertion. And this is where the main engine of the Trace Gas Orbiter fires in order to slow the orbiter down sufficiently that it is captured by Mars's gravity, which was a success. And this happened just

on this Wednesday. And where we are now is in an orbit called "Mars capture orbit" and we stay there for a few months.

And then in January, we'll undergo our inclination change, which prepares us for our aerobraking phase. And aerobraking is a technique where we use the solar panels of the spacecraft to generate drag. So we skim the upper atmosphere of Mars and the drag from the solar panels slow the spacecraft down. And by slowing the spacecraft down, you shorten your orbit and we're going to do this for about seven months. So we start early 2017 and then we'll be in our final orbit by the end of 2017. And that's when the science orbit begins.

KAREN FOLEY: Wow. We asked our audience what they thought the most dangerous part of the Trace Gas Orbiter journey was. 61% said aerobraking and 24% said the launch.

JON MASON: I probably agree with that. Aerobraking is a very dangerous part of the mission. You need to know the density of the Martian atmosphere to a very high degree, which we do but not 100%. And there is still a question mark on how long this aerobraking will take. You don't want to do too much. Otherwise, you might end up being too low.

So aerobraking I would say is a very risky part of this mission, again, as a whole. It has never been done before. This is the first time Europe has used aerobraking to slow the spacecraft into its science orbit.

KAREN FOLEY: And in terms of the GPS question we had in terms of how accurate we can get the Trace Gas Orbiter, 63% of our audience says within tens of metres and that was followed by 28% with hundreds of metres. So how much do we know in terms of that level of detail how close we are?

JON MASON: So about a hundred million kilometres away is several hundred meters, 500 metres. We know the position of the spacecraft, which is phenomenal, really. It's better than GPS on Earth. And this level of detail does need to be known. But yeah, it is within hundreds of metres.

KAREN FOLEY: Wow. So well done, the 28% of you who got that right. Yeah. No, absolutely phenomenal, like you say, that you can have that level of detail. It's often, I think, something that we take for granted but that must be very difficult to actually be able to monitor, as you say, with so many variables that you just, whilst you can know certain things, there are so many aspects that we don't know about.

So tell us then about some of these instruments on board. You've mentioned the NOMAD and you've mentioned the lovely clear divide between the ESA and the Roscosmos side of things. There are lots of instruments all doing quite different things. So the NOMAD's the part that you're involved with, which is three spectrometers. So this is all about investigating the atmospheric composition of Mars, isn't it?

JON MASON: That's correct, yes. What the Trace Gas Orbiter-- well, actually, it's in the name. It's going to look at trace gases in the Martian atmosphere, which are gases which exist in small concentrations, mainly methane. And for UVs, we're looking at ozone levels in the atmosphere. So methane has been detected on Mars before but not to the level that we require to fully understand where this methane is being produced. So we're looking at sources of methane and also where the sinks of methane are using NOMAD.

KAREN FOLEY: But there are lots of different things that are being measured, as well. We've got the FREND, the ACS, and the CaSSIS.

JON MASON: So you should think of instruments as a scientific laboratory where not one instrument will be defining, yes, there's methane, which means there's life. They're going to be working in concert to try and build a bigger picture of the Martian methane cycle. So we can detect methane with our spectrometers and FREND can detect subsurface water. And if we can correlate the release of methane with some subsurface water, it will give us a better understanding of what may be causing this methane on Mars.

KAREN FOLEY: So how soon will we know then if there are going to be any surprises, in terms of what we thought?

JON MASON: So the science orbit begins late in 2017 and our orbit allows us to get a very clear picture of the Martian surface very quickly. So we're hoping that within, say, maybe a month or two, once we get into orbit, we'll be able to start analysing and saying, yes, we've seen methane.

KAREN FOLEY: There's been a lot of press about the lander and the issues with that. And obviously, having something in terms of measurement from the orbiter that can actually look at the surface must be very, very valuable. But it hasn't been something that's been overly highlighted.

JON MASON: The orbiter is the most important part of this half of the ExoMars mission and it has been in the dark, in the back seat because the Schiaparelli Lander landing on Mars is obviously a bit more exciting than just saying, oh, we've got something orbiting. But that shouldn't detract from the

main object of this mission is the science and the Trace Gas Orbiter carries that science.

KAREN FOLEY: So how excited would you get if this Trace Gas Orbiter is able to detect methane?

JON MASON: That'll be huge and we'll be able to for the first time look at the dynamics of the methane. So how does it change, where is it coming from, and what's potentially producing this methane? And as Matt Balme said earlier, that has huge cultural implications for life on Earth.

KAREN FOLEY: No, absolutely. We had a really good question earlier that George asked. And obviously, something like this is a massive piece of equipment and we're not quite sure what happened to the Schiaparelli Lander. But he says, "What lengths do we go to to ensure that we don't transfer biomaterials to Mars?"

JON MASON: That's a very good question. So when you build instruments for space, especially going for Mars and landers, everything's done inside very clean laboratories. So you've got clean rooms and these are highly controlled environments where you have to get suited up into special uniforms. You wear gloves. If you've got a beard-- or you all wear face masks even if you don't have a beard. You've got to wear goggles.

So we try and keep the environment where these instruments are produced as clean as possible. That's not to say that some microbes might attach but we do the best we can to prevent microbes from Earth hitching a ride to Mars. And everything's done in a very clean environment.

KAREN FOLEY: Yeah, but like you say, it's not-- how would you then differentiate between what may have been transferred from an Earth environment to a Martian environment?

JON MASON: So if it's been transferred from Earth on the rover, then the Earth microbes, we can recognise them whereas if it's a Martian microbe, it will be different and we'll be able to differentiate between the two.

KAREN FOLEY: Yeah. OK, brilliant. Before we start looking at some of the science that's coming in that final phase that we're talking about in 2017, I wanted to see if there are any questions that we can put from the Hot Desk. Sophie and HJ?

SOPHIE: Yes, actually, we did have another question similar to what you're talking about, actually, from Antony. So he says, "Apart from a byproduct of life, what other ways or things could produce methane on Mars?" So what are the other things that could produce methane, the other

possibilities?

JON MASON: Yeah, that's a good question. So there are geological processes which can create methane. One is olivine mixed with water and that can create a material called "serpentine" and serpentinisation can release methane into the atmosphere.

You also have methane clathrates, like on Earth, which are ice with methane trapped in the ice. And as the ice melts, the methane gets released. So that can also generate methane. So those are two of the main processes which may cause methane to be released on Mars and are not associated with life.

KAREN FOLEY: Yeah. And Jan's going to be talking a lot about that a little bit later on when we look at the surface. So he'll fill us in on that more.

Before we end, could I ask about the science then that's coming? So you've said that we're having the third commissioning phase of operations. How long will that last?

JON MASON: So the third commission phase is going to be eight days long, which is two orbits in our current Mars capture orbit. And the commissioning phases are more to get the instruments ready for science. But we have the opportunity to actually observe Mars during two close passes in late November this year and that'll be our science return from Mars.

KAREN FOLEY: And then what are some of the measurements that are going to happen in that science phase?

JON MASON: So we'll be looking at the surface of Mars with our nadir channels, which will look directly at the surface and looking at the reflected light back. In those measurements, we'll be looking for the dust in the atmosphere because Mars is a very dusty environment and we can measure how much dust is there and what the properties of that dust are. We can look for things like water ice and also, UVs will be able to take the abundance of ozone that is present.

KAREN FOLEY: You'll also going to be taking a look at one of the moons, aren't you?

JON MASON: Yes. Well, my little project is I'm trying to image the Phobos, which is one of the moons of Mars. And that's my little project and trying to get an image of that so we can characterise it and build up a picture of where Phobos came from and just more information on it because it's not very been well-characterized.

KAREN FOLEY: "Your little project"-- I like that, rather like this little project. OK. Finally, I just wanted to ask about-- obviously, this can only happen when the orbiter's in a certain way. And there's going to be a change and they have these various manoeuvres, don't they? And in January, there's going to be a key turn of that manoeuvre in terms of the orbit inclination. How is that going to impact on things?

JON MASON: So actually with that, it's a good thing for us because we get an opportunity to do more science in January time next year but after this orbit change and that will allow us to do measurements which we will not be able to in our science orbit. So we'll be able to maybe take some polar measurements. So we'll go over the polar caps on Mars and take some measurements there and build up an image of what is it like at the poles on Mars.

KAREN FOLEY: Wow. Excellent. So bearing in mind your two projects then, which one are you most excited about, in terms? Is it getting these images of the moon or are you more excited about getting some of the data from NOMAD?

JON MASON: I have to say I can't wait until the science phase begins late next year and we start actually building up our understanding of Mars, building this, getting the data, analysing it, and actually showing people that this is what's going on.

KAREN FOLEY: So what are you going to do in the meantime?

JON MASON: In the meantime, I am very busy getting our programming ready, getting the pipeline ready to analyse this data, and get all the necessary pieces together so that we can quickly get the data, quickly analyse it, and get the results out to the public.

KAREN FOLEY: What is that time pressure like? Is it very real? Is it just to be the first to analyse the data or is there another reason for that?

JON MASON: No. For me, it's more just getting the data out there for people to see it and say, oh, wow, this is interesting. This is great. There is a time pressure to be the first to do it but for me, the drive is just to do it because it's the science that I'm interested in.

KAREN FOLEY: Yeah. No, absolutely and a very interesting time for everybody. I think also catching up on your sleep should be a priority right now because there are going to get lots of sleepless nights as soon as you get that data, I imagine. Hey, Jon Mason, thank you so much for joining me today. That's been a really, really interesting session.

JON MASON: Thank you.

KAREN FOLEY: And thank you also for bringing this to the studio. It's been really lovely having it here-- very inspiring. So yeah, thank you very much for joining us.

OK. Before I welcome our next guest to the studio, I'd like to take a trip to the Hot Desk and see Sophie and HJ. What is everybody talking about?

HJ: Well, we've gotten some food and cake here, which always, always happens and it's making me slightly jealous because it's about that time again, isn't it? But Veda says, "This is the best SHL so far and would really like the planet mobile, please." But I'm not sure that'll fit in the mail.

Maybe if you send us a picture of-- what was it-- clouds we're after today, isn't it, or maybe the view from where you are, then we can send you a poster instead. I think we could do that, couldn't we?

SOPHIE: I think we could just about.

HJ: But Ian also says, "The set looks really good with the model, the telescopes, and the backdrop of the stars," which I might sneak away because I think that's kind of cool, as well. And we're also very interested in the descent of the lander and about the shoot deployments. And has it been in contact yet?

So we've got lots of questions about that. And Rhian's taking us through all those stages later, which I'm really excited for and should answer a few of your questions there. So we will get to those and if there's any other questions you have for our guests, then yeah, just please let us know and we'll get them to our guests when they come in.

SOPHIE: Soon as we can, yes.

KAREN FOLEY: Lovely. Excellent. Have you been getting any emails, Sophie, from people with either clouds or study buddies or spaces or food?

SOPHIE: We have, actually. So we had some from Simon, a nice picture of clouds here at the OU. And we've also just literally just had one in from Emma. So we will try and get those printed off as soon as possible so we can show everyone. So thank you very much for sending those through to us and keep them coming in.

[MUSIC PLAYING]