“If you go to Mars, don’t forget your MOXIE!” – Prof. Jeffrey Hoffman

Bio: Prof. Jeffrey Hoffman is a former NASA astronaut and was the first person to spend 1000 hours onboard the space shuttle missions. As Claude Nicollier, a Swiss astronaut, he helped to repair the Hubble Space Telescope. They went on three different space shuttle missions together, which is actually a record for number of missions shared by a pair of astronauts. He now teaches in the Department of Aeronautics and Astronautics at the Massachusetts Institute of Technology, where is the co-director of the Human Systems Lab.

Mars

The exploration of Mars started in 1964 with the first successful flyby done by Mariner 4, a NASA spacecraft. Nowadays, it is not uncommon to send rovers to the surface of Mars, like Curiosity. Nevertheless, it remains a risky business, with a 7-to-8-month trip to the red planet, the 12gs sustained while entering the atmosphere or the 7 minutes of terror before knowing if your spacecraft actually made it to the surface.

There has been evidence of water on Mars and of a great ocean in the Northern hemisphere in the past, which could indicate life on Mars. But one thing is: if you’re going to look for life on Mars, you got to dig! This is why sending people is so important: there is a need for big mining operations to dig into the ice underneath the regolith. And therefore, there is a real need to develop in situ resource utilization (ISRU) research, which pretty much means living off the land.

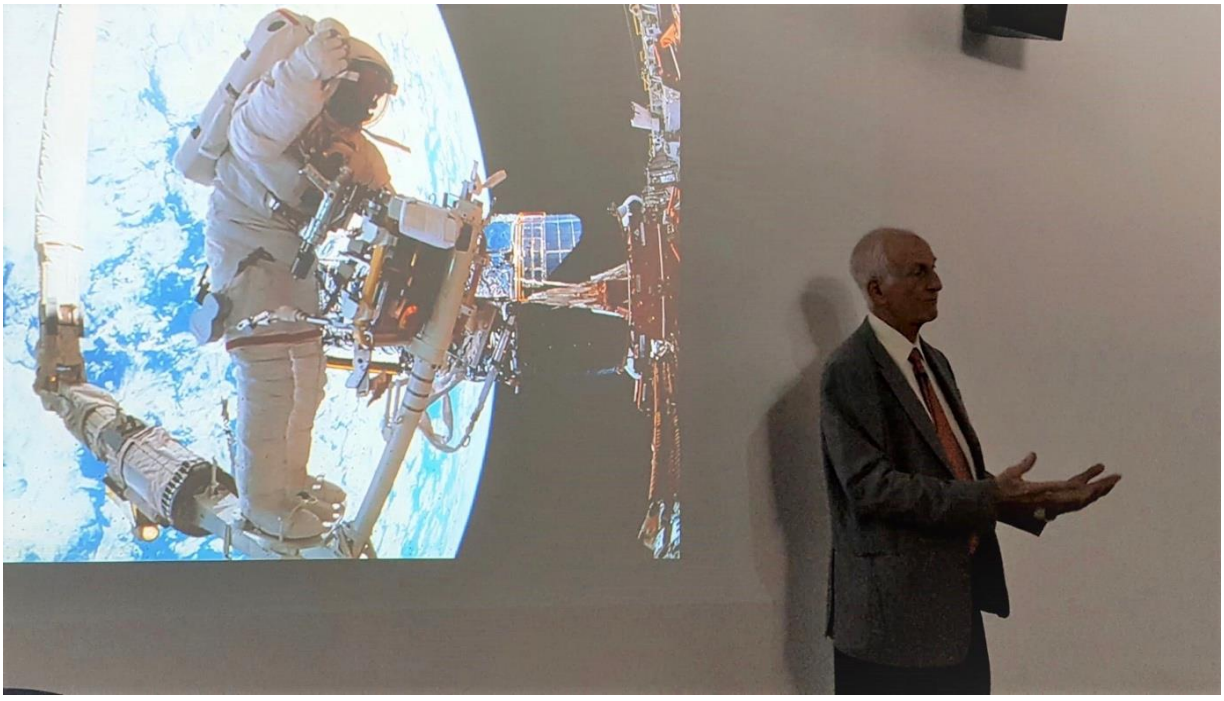

Figure 1: Prof. Jeffrey Hoffman at EPFL

MOXIE

Here comes MOXIE, the Mars OXygen ISRU Experiment, for Mars 2020[1], the next rover to be sent to Mars. This experiment has for goal to produce oxygen on the surface of the planet through 3 steps:

- Filter out the dust thanks to a dust filter;
- Compress the Mars atmosphere with a scroll pump;
- Electrolyze the CO2 to liberate oxygen with the SOXE (Solid Oxide Electrolysis).

Note that the output will not be used during this mission, it will only be measured thanks to sensors. Sensors and control can measure pressure, temperature, flow rate, current and voltage. The entire process has to be completely autonomous. However, the experiment requires a huge amount of power, about 300W to run, which means all the other programs on the rover have to shut down in order for the experiment to function. This is a joined project between NASA Jet Propulsion Lab and MIT and it is already installed in the rover, ready to go! It will soon be on its way to the Jezero Crater on Mars with other experiments like the first helicopter, or the Terrain-Relative Navigation (autonomous landing at the right spot).

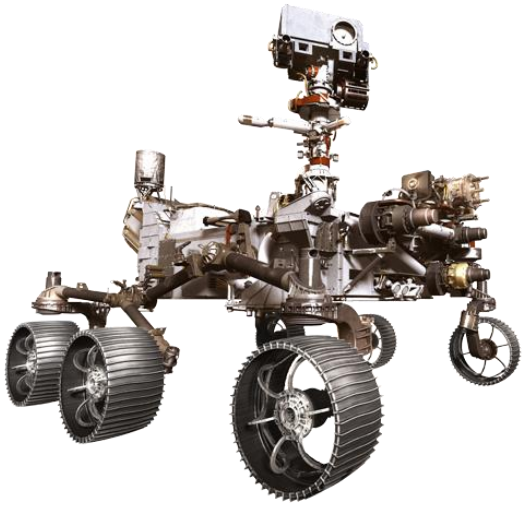

Figure 2: Mars 2020 Rover, NASA

MOXIE will be a big step for the establishment of humans on Mars, not because it will provide oxygen to breathe but because it will produce rocket propellant to get off the surface once it's time to go home! Current computations give 14 months to fill the two tanks useful to lift off the red planet. But the process would need to produce 3 kg/hour of oxygen, and this would need 25 000 W to function! It is about 80 times more demanding than the actual prototype.

Mars is getting closer and closer for human exploration and as Prof. Jeffrey Hoffman says, the point is: "If you go to Mars, don't forget your MOXIE!".

[1] Temporary name to be changed at the end of October 2019