Dr. Robert Zubrin is President of the Mars Society. The questions in the interview are from the IJSTMI Editorial Board.

IJSTMI: Do you think it is possible another organization possibly a private company like Space-X to implement a Mars Mission?

Dr. Zubrin: Yes with a Falcon heavy vehicles and scaling the mission to 3 launches. The question rises could you use that they actually do a Mars mission? and my answer came up «YES» provided that you scale the mission down from a crew of four, to a crew of two and use three launches per mission instead of two and I prefer to do these missions without any in-orbit assembly just direct launch to Mars in three discrete packages (see Figure 1).

One package positions in Mars orbit an Earth return vehicle but with no one in it, but with the propulsion required to send to it from a highly elliptical orbit back to Earth, another sends a Mars ascend vehicle to the surface, which bring its fuel methane but which has a machine with it for making oxygen out of the carbon dioxide Martian atmosphere to fill up the oxidizer tanks (see Figure 2). Because the oxygen is three quarters of the propellant, so if we could make the oxygen right there you have made a tremendous mass saving so that is the Mars ascend vehicle and once those two are in place you send a third vehicle. Which is a habitat craft with the Astronauts in it and they fly up to Mars and aero capture and then go and land on the Martian surface near the Martian ascend vehicle and use the Habitat Craft as their base and in the end of the mission they get back to the Mars Ascend vehicle and fly to Mars orbit rendezvous the return vehicle which then returns them back to Earth.

As far as the flight systems are concerned I am recommending the Space-X capsule called the Dragon (Figure 3), which is comparable to the Apollo capsule which was used during the Moon programme. While it is rather confining it can
be expanded with an **inflatable extension** and if you make this is inflatable extension that can have 6 meter in diameter and 8 meters long so that we can create 2 decks each with plenty of heavy room and about 50 m² of floor space and a modest flat in which one can live and is plenty of space for two.

We create artificial gravity on the way to Mars by tethering this assembly off by the trans Martian ejection stage and spinning it up and thereby, avoiding the health effects of zero gravity (see Figure 4)

**IJSTMI: How do you deal with the health effects on astronauts and radiation shielding?**

**Dr. Zubrin:** OK if you see those charts you will see the radiation doses a number of astronauts and cosmonauts have in fact received already in the space station program and you can see that there are five cosmonauts and one astronaut, who have received radiation doses already that are greater than have they gone to Mars and back and several more astronauts that have received almost the same amount of radiation as if they have gone to Mars and back (see Figure 4). And none have experienced any radiological health impacts because in fact the radiation dose depending on the design of the mission is going to be between 15 and 100 millirads (mrad) perhaps and may be even 130 millirads (mrad) on a badly designed mission and these represent a one percent risk of getting cancer. So in this case I would try to have nine people and each of them have one or two percent of having cancer, the chance is that none of them would have gotten cancer.

So this is overdrawn and I might add that the radiation risk on this mission I am proposing is absolutely the same as the radiation risk that would be encountered on any other Mars mission no matter how expensive. Because the correct orbit to fly to Mars is an orbit that takes **6 months to go to Mars** and you spend a year and a half on the surface and 6 months back and that is the trajectory you want to you use no matter whether you have a crew of four or a crew of eight or a crew of two. So that is what is involved in a Mars mission and I would add that the cancer risks are considerably small of that involved in smoking.

**IJSTMI: How do you precede 30 tonnes of P/L on the surface of Mars when current systems can land only 900kg?**

**Dr. Zubrin:** Well we are talking about using a heavier booster the Flacon can lift a 53 tonnes to orbit which means that it can send around 17 tonnes on the surface of Mars injection and land around 11 tonnes on the surface of Mars. We would use the aero shell of the Dragon which is designed for orbital entry and pop a drag parachute to slow down under a speed of 100 m/s and then use rockets to terminal deceleration.

**IJSTMI: What will be the challenge for private companies for participating in your mission? What are the new space applications and benefits that private companies extract using that concept from future Mars missions?**

**Dr. Zubrin:** if we just take the concept I outlined we are talking about doing a Mars mission for three launches using the Falcon heavy launch vehicle which costs 100 Million USD each which makes it a total of 300 Million USD for launch, may be a couple hundred million dollars for the other systems that’s half a billion dollars that is **less** than the cost of one Space Shuttle launch. So this something which NASA can readily afford to do, ESA or the Russian Space agency can readily afford to do.

Mars exploration if **affordable** now if you are talking to do this on private money it is possible to, but I do not think that you can do this based on profit. Because if someone is primarily motivated by profit, there are much safer investments they can make then this, but there
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