Hi this is Steve Nerlich from Cheap Astronomy www.cheapastro.com and this is *A mission to Mars.*

You might have heard Barack Obama talking about a mission to Mars by 2030. This follows George W Bush's plan for a mission by 2020. And even that was just history repeating itself. As the relevant Wikipedia page says: *Missions to Mars have been under consideration since the 1950s, with each such mission typically planned to launch 10 to 20 years in the future.* So really Obama has just moved the goal posts another 10 years into the future – and whoever comes after him will probably do the same.

The Bush plan never really seemed realistic since NASA did not get any new money and, perhaps as a consequence, the components of the Constellation project always seemed a bit underdone. It's unlikely that many people in the business are sorry to see plans for the Ares 1 scrapped and plans for the more realistic Ares 5 have morphed into plans for the SLS (which just stands for Space Launch System) the first heavy-lifting rocket that will exceed the power of the Saturn V. And to give credit where it's due, plans for the manned Orion spacecraft, essentially a bigger version of the Apollo command module, have since progressed to building a prototype, which might see a launch test as early as 2014. So, the Constellation project did make some progress.

Anyhow, Obama's planned mission to Mars will just go into Mars orbit in the mid-2030s. As far as a landing goes, Obama just expects to see that happen in his lifetime. In other words, the landing mission might happen 10 to 30 years after an orbital mission that is at best *planned to launch* more fifteen years from now. So, there are no iron-clad guarantees here.

The real problem is the same problem that has always faced a manned-Mars mission – it is freaking dangerous. Even with a genuine long-term political commitment to get the job done, backed by a multi-billion dollar budget – neither of which we have at present – you are still looking at maybe a 90% chance of success. It is not likely that any major government will consider that to be an acceptable risk for a multi-billion dollar project that will have a multi-billion person audience.

A three day mission to the Moon was dangerous, but as we showed with Apollo 13 – even if something goes catastrophically wrong, you are still only 3 days from a ham sandwich. The Apollo 13 rescue mission took advantage of orbital mechanics to swing the crippled spacecraft around the Moon and get back on a quick return trajectory. Although there is also a free return trajectory you can follow if something goes wrong on the way to Mars - you will be more like 300 days from a ham sandwich.

With a Mars mission, once the ship is in a solar transfer orbit, struggling to climb up the Sun's gravity well towards Mars, the Earth will begin to overtake it. Six months after launch the Earth will be on the other side of the Sun from where it was at launch – while the spacecraft may still be climbing towards the slower moving Mars. So, if there's the slightest change in trajectory or velocity that can't be corrected, you can forget about ever seeing a ham sandwich again.

So, one solution is… get over it. People die all the time and even though we will have spent a truckload of money – that money created new technologies and new jobs for lots of engineers and science graduates. It would certainly be a grim business listening back on Earth as a team of astronauts, who will become international celebrities, die a slow death as

the oxygen bleeds away from their spacecraft. But even knowing all those risks, could you still get people lining up to be Mars astronauts? Of course you could.

Gathering together a crew of totally-dedicated, ridiculously-fit, post-doctoral-specialist wunderkind is never going to be the problem. Getting someone to pay for the mission is going to be the problem. So really, if you want to fly to Mars, the first thing you should be aiming for is world peace. This will enable a cartel of prosperous countries to divert their current defence budgets to a Mars mission. But that is just the first thing.

If you really do want to return your crew safely to the Earth, you are going to need a radiation-shielding solution against the episodic risk of solar flares and the continuous risk of high-energy cosmic rays of a galactic or extra-galactic origin. We are yet to fully quantify just how bad these risks might be – but, in any case, we have never flown anything that could guarantee the protection of its crew in such a hostile environment.

In retrospect, the Apollo astronauts were just darn lucky, because the period 1968 to 1972 was a solar maxima period. Apollo 17 flew in December 1972 and recorded a maximum skin dose radiation exposure of 1.14 rads. In retrospect, it is estimated that the coronal mass ejection that happened in August 1972 would have exposed the astronauts to a skin dose of 400 rads – enough to induce Acute Radiation Sickness and life-threatening cancer in the longer-term, presuming that they all survived the Acute Radiation Sickness.

You can surround your spacecraft with shielding – but the additional mass loaded onto the spacecraft would bump up your fuel requirements exponentially, which will bump up your mission budget exponentially. Exponentially is one of those words that might not mean a lot until you get the bill, but it doesn't look good on a funding application.

The only alternative is some kind of Star-Trek electromagnetic shielding that deflects incoming particles without absorbing their momentum energy. This is still pretty much science fiction.

But OK let's assume that we achieve world peace, we do come up with the money and with a practical radiation-shielding solution and the international cartel of nations who are funding the mission develop a somewhat carefree attitude to astronaut survival.

What we could aim to do is to fly the first Mars mission during a solar minima, one of which is due around the mid-2030s. Nonetheless, you still have to deal with the orbital mechanics of launch windows and return windows, so with current propulsion technologies, your options for a Mars mission are:

1. The 30 month standard mission using the good-old fuel-efficient Hohman transfer orbit. This way means 7 months there, 15 months to stay and then it's 8 months back home.
2. The 18 month economy class mission. You still do the 7 months out – but, you only stay one month and then it's a gruelling 10 months to get home.
3. The 'even if you don't die, we don't want you back' option. You fly there and you stay there. Since you don't need to conserve fuel, you could pull out all the stops and reach Mars in just 5 months.

The real point to this podcast is to suggest there are some fundamental practicalities abpout a 3-500 day Mars mission that we aren't really grappling with yet. Progressing from a Moon mission to Mars mission is a bit like deciding that you can climb Mount Everest because you climbed a steep flight of stairs yesterday. If you want to raise the likely success of a Mars mission from 90% up towards 100%, you will probably need to expand your mission budget by 90%. Those extra dollars will fund en-route consumables depots, the Mars-orbiting re-supply platform and a robot-maintained base on the surface.

Once we realise the level of investment that will be involved in doing just one Mars mission, we may come to realise that doing one Mars mission is just impractical. So, in the long-term it won't be about a Mars mission, it will be about a program with a more sophisticated objective than just leaving a boot print on the planet. And even though we seem hopelessly ill-prepared to make this happen in the mid-2030s, it will happen some day.

And if you want that day to come sooner rather than later, why not start by achieving something easier, like world peace.

Thanks for listening. This is Steve Nerlich from Cheap Astronomy, www.cheapastro.com. Cheap Astronomy offers an educational website reminding you that when your life's at risk – send the robot first. No ads, no profit, just good science. Bye.