Pfammatter_2000

MARS FAST FORWARD

Robert J. Pfammatter*

Traveling to Mars is no easy task, but as many of us know {Mars Society members especially} not impossible. From the book -Case for Mars--by R. Zubrin we also know that we can do this with existing technology for a price that is not out of line with some of the military programs about- 20 billion dollars.

What would happen, you might ask, if some new technology is introduced and the mission is scaled down [fewer astronauts etc] faster transit time, with less weight leaving LEO. This is the type of mission that I want to talk about. The vehicle [spaceship if you like] in this scenario, would get to Mars in 120 days or less and carry two astronauts.

To think about this plan we need to put aside the large heavy and extremely costly programs proposed previously and forget the movies of trips to Mars previously screened. If we go back to World War II for example - the challenge was to build lighter airplanes, with more power, higher speed that could carry heavier loads. This challenge was met on both sides of the Atlantic. The B-17 bomber, and Messershmitt Me 109 fighter are just a few examples of aircraft designs that met or acceded the stringent expectations that were required at that time.

The spacecraft has more or less these same variables to contend with and I might add with one big advantage---no atmosphere. What does this mean? It means that there is no drag, nor requirement for aerodynamic surfaces. The empty weight of the ship [spacecraft] could possible weigh less than a B-17 but more than a B-25 Mitchell bomber say about 15tons. If this can be done, obviously the propulsion requirements would become much smaller and more doable. Recent advances in composite materials will make it possible to construct O_2 & H_2 tanks that are safer, smaller and easier to handle in space. It is still a good idea of course not to bring along pressurized tanks for the majority of the trip to Mars. As we know from Apollo 13 a tank disaster can be catastrophic and end the mission in short order.

Going back to the spaceships basic structures, let us remember that the world aircraft builders [Boeing etc] have done an excellent job in building lightweight pressurized aircraft structures. This same technology can be used in a ship that will go to Mars.

With this brief background in mind let us thus examine in more detail how to go to Mars in 120 days or less and also use the Moon to assist the trajectory. All my numbers are approximations or estimates, and arrived at using basic principles [rocket equation etc]. The spacecraft, I like to call it a ship since there are many similarities, is a ROMULAS type vehicle [rapid orbital mission ultralight astronomical ship]. The total mass in LEO [low earth orbit] is approximately 160ton.

---

* Studio Chamisa, Taos, New Mexico tel: 505-751-3234

The ship consists of 3 RL10 engines, 6 LAMP engines [lightweight augmented methane propulsion], a nuclear electric module, crew of 2 with provisions as well as tanks and materials required for burn times as required for the trajectory. As mentioned before the bare bones ship has a mass of 15 tons and all the additional mass consists of propellants, provisions, engines, the nuclear-electric module and crew. These items are either stored on board, or attached to the outside of the ship. A general breakdown of these weights (masses) are as follows: RL10 engines, tanks and propellants approx. 89 tons; nuclear electric module, [by far the heaviest module for obvious reasons] 21 tons; provisions for crew of two,13tons; chemical module 3 tons; LAMP engines and their propellant and storage tanks 20 tons; Mars lander 9 tons. The ship would be assembled in LEO fairly rapidly not at all like the space station. It would fit together in a clever and simple way.

On earth it could be preassembled in a matter of weeks and in space somewhat longer since testing of subsystems, electronics etc, after the pressure hull is complete, is required. The engines and propellant tanks would slip into rack's and secured, and quick disconnect lines attached were required. Simple connections as used in the gas industry could be employed to attach the pressurized propellant lines. I will describe the important components of Romulas in more detail one at a time.

The major module for power is the nuclear module, which consists of a very small efficient nuclear reactor coupled with turbine generator, Fuel Cell and turbo-pump. The electric power will than be used for both the chemical reactor to produce methane, oxygen and hydrogen and also for the efficient low thrust LAMP [lightweight augmented methane propulsion] engines. This propulsion (the six LAMP engines) is what makes a trip to Mars doable in a timely manner. These motors consist of existing afterburner technology and are variable thrust engines with a high thrust of about 300#, a low thrust of 10# and they would weigh less than 1000# each. The central combustion chamber would utilize new technology magnetic resonance [MHD-magneto hydrodynamics] to achieve high exit velocities and efficiencies. The central exhaust stream would then be augmented with small quantities of O2 and methane depending on thrust requirements as well as propellants on hand. Since the LAMP's are a hybrid engine between a rocket [low eff.] and MHD [hi eff.]--xxxisp, the additional mass requirement for propulsion is quite small (9+ tons).

The path to Mars, I want to describe next, so that we might understand the big picture of interplanetary travel. First of all orbital mechanics are quite complicated and trajectories are never straight lines. There is, however, an optimized vector (direction) that the ship needs to take when leaving the influence of the moon. This vector can be controlled by both speed and flyby distance to the moon's surface. In order to simplify and not use governing equations a few observations on the orbital characteristics of the two planets needs to also be mentioned. As we know, mars never gets closer to the earth than 34 million miles. Previously missions were simplified in order to save fuel and guarantee success. Satellites, landers etc sent to the red planet thus traveled great distances and took a long time to get there [over 200 million miles and in access of seven month].

With the Mars Fast-Forward program additional velocities imparted to the ROMULAS spaceship makes the time and distance much shorter. Also the path the ship takes to Mars is more complicated, but generally speaking is in the shape of an 'S' since it continues to accelerate upon leaving the Earth-Moon system and upon arriving near the red planet will decelerate so that it will be able to be captured by the Mars gravity field. The first phase of the journey would employ 3 RL10 engines, [these are reliable existing engines] and fire for about 32 minutes bringing the ship to a speed of about 2.3 miles/sec greater than its orbiting velocity. This is enough to escape LEO and bring the ship to the Moon in a less than 2 days. At that point in time the tanks and two RL10's would be jettisoned and possible crash onto the Moon as the ship catapults its way to Mars.

Here the fun begins**--**or rather maybe the more interesting phase of the journey to Mars. The Romulas ship is now ready to engage that vast ocean of space between Earth and Mars. Since it already has the same tangential velocity of the earth that is about 19 miles/sec plus the acceleration provided by the powerful RL10 engines [2 miles/sec]. And then again the loss of mass, 89+ tons, since casting off those high-pressure tanks of O2 &H2. We could say the result is a Lean and Mean Space-Machine. Even without the sling shot effect of the moon, we now have a system that could get to Mars in 6 months, similar to Zubrin's Mars Direct.

After leaving the earth-moon system, the other elements of the ROMULAS ship come into play. The Lamp engines are started, and will bring the ship to its cruising velocity, called the hyperbolic velocity of about 6miles/sec. Since these engines will fire for about ten days, the acceleration requirements and thus the thrust requirements will be quite small. The methane that they will use at this point will be stored in LP tanks as is the hydrogen and oxygen. The H2O tanks are not pressurized but need to be heated so that they will not freeze. Due to this advanced tech propulsion (that is very high specific impulse on the order of xxxisp) the tonnage for fuel and oxidizer are very small compared to that used by the high thrust and thirsty RL10 engines. Also the chemical module will be started so as to provide methane, oxygen and hydrogen to replenish the supply used on the trip over. It will do this from the stores on board of CO2, hydrogen and water. This new fuel generated will be used when the LAMP engines fire to decelerate the ship upon its approach to mars. After traversing an elliptical path of about 120+- million miles the ship, going faster than Mars, will catch up and needs to slow down for about 10 days.

This then, is a way to get to mars in a reasonable period of time. Many different scenarios could take place if a ROMULAS type spacecraft were available. One being, if we sent 3 ships to mars, each with a crew of 2, more resources and astronauts could visit the red planet. In this case, before slowing down for ten days, a crew exchange plus some provisions are done between ships. Now we have 4 astronauts in ROMULAS III and one each in the other two ships [quick return around Mars]. After orbiting the red planet 2 will stay with the ship and 2 will depart to Mars in a small lander, ala the Apollo program [with the addition of parachutes]. They, those on Mars, will go to a LEM type vehicle, previously dropped off by a supply ship. They could stay for an extended period and be supplied by Care packages from earth and work on their habitat.

To summarize therefore, it could be said that with existing technology, some new technology that could be deployed in the next six years, and incorporating the lessons and good ideas of the past we can move rapidly forward with a manned mission.

As in the past, exploring the world by ship was no easy task either--money, as is the case today, was hard to come by and the ships were pretty small and cramped. Just recall the voyage of Columbus and how many inhabitants on the planet at that time believed in his vision-- I thus rest my case for a trip to Mars.